Automated Support for Naval Ship Acquisition Management

Technical Report
December, 1980

ROH, Incorporated
2001 South Jefferson Davis Highway
Suite 1105
Arlington, Virginia 22202

Computer Corporation of America
575 Technology Square
Cambridge
Massachusetts 02139

Automated Support for Naval Ship Acquisition Management

Technical Report
December, 1980

Prepared for:
Office of Naval Research
800 North Quincy Street
Code 437
Arlington, Virginia 22217

Prepared Jointly by:
Computer Corporation of America
575 Technology Square
Cambridge, Massachusetts 02139

Contract Number:
N-00014-79-C-0927

ROH, Incorporated
2001 South Jefferson Davis Highway
Suite 1105
Arlington, Virginia 22202

Contract Number:
N-00014-79-C-0928

Table of Contents

Summary

Navy acquisition managers can be provided with improved information and better decision support tools than are currently available to them through the application of recent advances in information technology. Of several acquisition management areas that could benefit from that technology, acquisition planning has the potential for the most immediate and important gains. This conclusion is the result of analysis by ROH Incorporated and Computer Corporation of America, a team with expertise in both Navy acquisition practice and relevant computer technology. The team interviewed managers in NAVSEA and NAVMAT, collected and studied an extensive library of relevant documents, and employed a recognized system analysis methodology in reaching this conclusion.

This report presents that analysis of acquisition management activity, supports and details its key conclusions, and defines the scope of the necessary work to follow. The key recommendation is that the Navy continue with a detailed study of acquisition planning and related activity, with the goals of:

1. Specifying requirements, in detail, for automated support;
2. Defining alternative system concepts to satisfy these

requirements; and,

3. Recommending one concept of implementation, on the basis of a systematic evaluation of technical and management factors.

The present report also describes some relevant technology which is expected to provide the key elements of a system to satisfy acquisition management needs. These elements - in the areas of data management, decision support and business procedure management - can be combined in an integrated design, based on a fuller understanding of requirements. Presentation of these technical concepts in this report is intended to suggest the type of system that may be feasible and appropriate. We stress that a definitive system concept must await further analysis.

This report was written jointly by ROH, Inc., and Computer Corporation of America (CCA). ROH is familiar with Navy acquisition practice, and has successfully designed, implemented, and supported ship acquisition systems. CCA is performing the leading research and development in several areas of relevant computer technology, and specializes in applying this technology in large scale, operational systems.

Approach

Beginning with a very broad work statement, the team focused -- with Navy concurrence -- on management of ship acquisition. Within that scope, the thrust of the effort

has been to define those functional areas for which the application of advanced information technology holds the promise of greatest benefit.

After cataloguing the functions comprising the acquisition process, the project team identified and interviewed a number of high level individuals in the ship acquisition community. The primary purpose of the interviews was to elicit opinions on which of these functions were particularly important and needed better information.

The interviews indicated that the area of greatest immediate interest and potential benefit is acquisition planning. Specifically, three major components of the activity are of special interest:

1. Impact analysis, which has to do with assessing the impact of a proposed strategy, plan, or change thereto;
2. Change Management, which deals with implementing changes; and
3. Project Histories, which involve creating an accurate record of what actually happened during the life of an acquisition project. These will facilitate the quantification of key planning factors, which in turn support impact analysis.

In the context used here, acquisition plans include both programmatic and technical documents.

The reasons stated by interview respondents for

emphasis on acquisition planning were:

a. decisions made early in the life of an acquisition have the most impact on its success;
b. the visibility which acquisition planning information receives outside the acquisition community;
c. a perceived need for a systematically organized "corporate memory" regularly refreshed with recent history which can be a major source of insight for contemporary acquisition managers planning future acquisition activity;
d. a desire for a common "fact base" available to Navy acquisition projects, fostering for the Navy an image of greater consistency;
e. a belief that creating and changing acquisition plans, whether programmatic or technical, are where considerable delay and extra cost are introduced into the acquisition process.

Analysis and Recommendations

On the basis of these remarks, a preliminary analysis of the acquisition planning activity was conducted. A systematic description of the relevant functions was developed. Potential benefits of improving the activity -- specifically impact analysis, change management, and project histories -- were identified, including:

- improved decisions due to more accurate and informative evaluation of alternatives, and
- more effective execution of plans through improved com-

munication among acquisition participants.

Impact analysis projects the effect, perhaps across projects, of proposed technical and programmatic strategies or plans or changes to them. Managers require more accurate and timely information than is currently available in order to select among acquisition alternatives. We therefore recommend detailed analysis of the requirements for information technology support of three types of impact analysis:

1. Statistical based -- This method uses project histories to summarize past experience across all projects or across projects with specified characteristics. Managers can make projections based on cumulative and trend statistics.
2. Case history based -- This method uses project histories to retrieve experiences on individual projects with specified characteristics. Managers can make projections based on their interpretations of related case histories.
3. Model based -- This method uses models (of varying complexity) to simulate and project acquisition results. These models may be based on information extracted from project histories. Managers can use the models to make projections based on various assumptions, constraints, or resource commitments.

Since project histories are important in all three methods of impact analysis, further study is required to define the precise nature and content of these histories.

Change management is the function that records the decisions and notifies appropriate members of the acquisition community. Accordingly, we recommend a detailed requirements analysis to determine how information technology can support

- recording programmatic plans in a form allowing direct transcription of approved changes,
- recording programmatic and technical changes, and
- notifying interesed parties.

Based on the concerns and needs identified by interview respondents, several kinds of technology to aid acquisition management are presented:

- Business procedures and communication (office automation)
- Electronic mail
- Decision support systems
- Distributed databases
- Graphic user interfaces.

These can be combined as needed.

Request for Comment

Specific review, comment and concurrence or alternative direction is requested from the Navy on this recommendation. Such review and direction will ensure that subsequent work will produce the desired results.

2. Goals, Objectives, and Approach

2.1 Goals

The goal of this program is to improve the Navy acquisition management process through the application of advanced information management technology. The effort will provide acquisition managers with necessary information that is accurate, complete, and timely, and with tools to provide help in acting on that information -- tools to generate and evaluate plans, implement and manage changes, and coordinate decisions and actions across organizations. This will be provided by appropriate database, communications, and decision support technology.

Our first goal is the improvement of ship acquisition. Other areas, such as weapons systems, aircraft, and electronic systems will be examined on the basis of experience with ships.

This report presents the approach and results of our efforts to define the scope of the acquisition management problem to be solved. The effort consisted of the follow-

ing steps:

- determine specific user groups within the acquisition community,
- define the management problems and concerns of those groups,
- define the functions and information relative to those concerns, and
- select areas for analysis based on technical and organizational feasibility and desirability.

The result of that final step is presented in this document as a recommendation to perform a detailed requirements analysis in the area of acquisition planning.

2.2 Contractor Relationship

This project is a joint effort by two prime contractors, ROH Incorporated and Computer Corporation of America, under contract to the Office of Naval Research. ROH brings its extensive experience with the Navy to this project; CCA brings its experience in requirements analysis and advanced database and communications technology.

2.3 Approach

The approach taken in this effort includes the following steps:

1. Identify the organizations within the ship acquisition community for which support is desired.

2. For each of these organizations, conduct interviews to gain understanding of its
   a. environment,
   b. current functions,
   c. concerns and goals, and
   d. desired functions.

3. Identify existing functions and the information used or produced by them. These functions will include decision, decision support, review and policy making activities. Describe these functions and information within an overall framework.

4. Identify common concerns and goals within this framework, noting cross-organization impacts.

5. Based on perceived benefit and technical and management feasibility, recommend areas for further analysis and subsequent support.

Steps one and two of the approach were implemented by interviews and document surveys. Where possible, informa-

tion was first obtained from the documents (see document library, Appendix B). Interviews were then conducted, with responses to be reported without attribution to any respondent. As the interviews progressed the questions evolved based on the analysis team's perception and

understanding of the problem. The emphasis was on discovery. Questions were open-ended to preclude restricting respondents to a narrow channel of thought.

Figures 2.1 and 2.2 list the names and organizations of the interview respondents.

The information gained from the interviews and document surveys was documented in a Structured Analysis and Design Technique (SADT) model (see Appendix D). This analysis methodology was selected because of its suitability for analyzing and describing the acquisition management process, without regard for automation; the results of analysis using that methodology are useful in selecting and justifying the functions and information to be automated.

The SADT model was used as the framework for further questions, surveys and analysis. All concerns and goals were projected onto this framework (see figures in Section 3); in this way, information-based solutions proposed within the framework can be reviewed to determine how com-

---

SADT is a registered trademark of SOFTECH, Incorporated.

PERSONS FORMALLY INTERVIEWED

RADM Otth	MAT 08
RADM Eustace	SEA 90
RADM Catola	SEA 04
RADM Beecher	SEA 93
RADM Lisanby	SEA 03
CAPT. Skolnick	PMS 405/PM 22
CAPT. Underwood	PMS 400E
CAPT. Peebles	PMS 396
Mr. Banko	PMS 389
CAPT. Huber	MAT 08D

PERSONS INFORMALLY INTERVIEWED

LCDR L. Sadauskas	SEA 90
CAPT E.R. Burdon	SEA 90
CAPT. C. Piersall	PMS 377
CDR. J. Elliott	PMS 377
Mr. R. Link	SEA 90
CDR. R. Teague	SEA 90
Mr. R. Bassett	SEA OOD
Ms. A. Allison	SEA OOD
Dr. A. Feiler	Log An, Inc.
Mr. J. Kammerer	MAT 01G
CDR R. Clark	MAT 01
CDR. L. Shaffer	MAT 08 D
CDR. S.P. Carpenter	SEA OOB
CDR W. Pfister	PMS 377
CAPT. E. Mortimer	PMS 383
Mr. R. Swart	PM-2
Mr. D. Whitenight	SEA 90R
Mr. D. Woytowitz	PMS 399
CDR. T.M. Shortal	DDGX
CDR. T. Hassler	PMS 393
Mr. W. Hirsch	PMS 393
Mr. J. Schrader	PMS 303
CDR. J. Colangelo	SEA 05
Mr. J. Keating	SEA 074
Mr. P. Barksdale	PMS 383
Mr. V. Bright	PMS 383
Mr. F. Anoskey	PMS 400

Figure 2.2

pletely they address the concerns and goals.

Appendix D presents the complete framework, which consist of the SADT models. Each box is labeled (below

and to the right) with a model name (in this case an organization or organization code), and an activity identifier (such as A21). Section 3 presents a discussion of the issues identified during the interviews, and their relationship to the framework; the figures in section 3 are excerpts from the framework, and boxes in the figures are labeled the same as their corresponding boxes in the framework. Section 4 contains the recommendations for further study and solicits Navy concurrence and comment. Section 5 presents a discussion of some support systems that satisfy various aspects of the requirements.

3. Interview Findings and Analysis of Results

3.1 General Findings

Interview respondents often discussed the need for information and other concerns in the context of a functional area. These areas of concern are:

1. Acquisition planning
2. Cost estimating
3. GFE/GFI management
4. Project financial management
5. Preparation/dissemination of management plans
6. Project problem management
7. Contracts and personnel administration

The team encouraged the interview respondents to describe the value of information in decision-making functions. Two significant observations emerged:

1. Decisions made in the early stages (prior to DSARC Milestone I) can generally be the most significant ones made during the lifetime of an acquisition, in terms of impact. Information needed for such decisions is therefore more valuable.
2. Decision-making and review functions fall into two

categories:

- fundamental functions that must be performed in all circumstances, and
- risk avoidance functions, which are de-emphasized in times of mobilization or crisis.

Respondents placed higher value on information associated with decisions of the first category. These two observations help explain the higher priority given to some concerns and goals described in section 3.2.

In discussing the potential for automated support to collect, share, and disseminate information, interview respondents cited two criteria for acceptance:

1. Any automation must not be disruptive to the organization using it; and
2. Automated support must allow an organization to keep information private until distribution is authorized by the owner.

These issues are addressed in section 3.3. Generally, the project team found that information has not been willingly shared because embarrassing or confusing situations resulted when incomplete, inaccurate, inconsistent, or untimely information was used. Correcting these deficiencies and providing the privacy of data will improve information sharing.

One general finding has impact on a support system's required flexibility. Discussions with interview respon-

dents regarding the relationship between information and decision-making revealed that all saw their decision-making as unstructured and largely reactive to external stimuli. This finding is probably related to the fact that most of the formal interview respondents were project managers or higher in authority. Selecting appropriate target areas to support will therefore require support system capabilities ranging from flexible ones to highly structured ones.

The following section (3.2) describes the interview respondents' acquisition management concerns and goals. These are discussed in descending order of value, based on:

- perceived need
- potential for improvement
- potential for support by information management or decision support technology.

The descriptions are illustrated with figures extracted from the overall framework that was used to correlate raw interview results. This framework, describing specific activities (boxes) and their associated information needs and products (arrows) is shown in full in Appendix D.

3.2 Acquisition Functions

3.2.1 Acquisition Planning

An acquisition involves creating program plans and technical plans and then executing those plans. Technical plans include ship design products such as drawings, specifications and bills of material. These technical plans evolve ideally through a series of states referred to baselines, such as conceptual or functional baselines. Program plans include a Ship Acquisition Plan, a Test and Evaluation Master Plan, an Operational Requirement, and Ship Project Directives.

Acquisition planning has three major functions as shown in figure 3.1. These are: (1) generate acquisition alternatives and strategies, (2) evaluate choices, and (3) implement selected alternatives. As the figure shows, a major input to the evaluation function is previous experience in the form of project histories. Interview respondents identified their acquisition planning concerns to be the evaluation function (called impact analysis), the implementation function (called change management), and the information on past experience (systematic project histories).

- Impact Analysis is the function that largely involves answering "what if?" types of questions. It is the

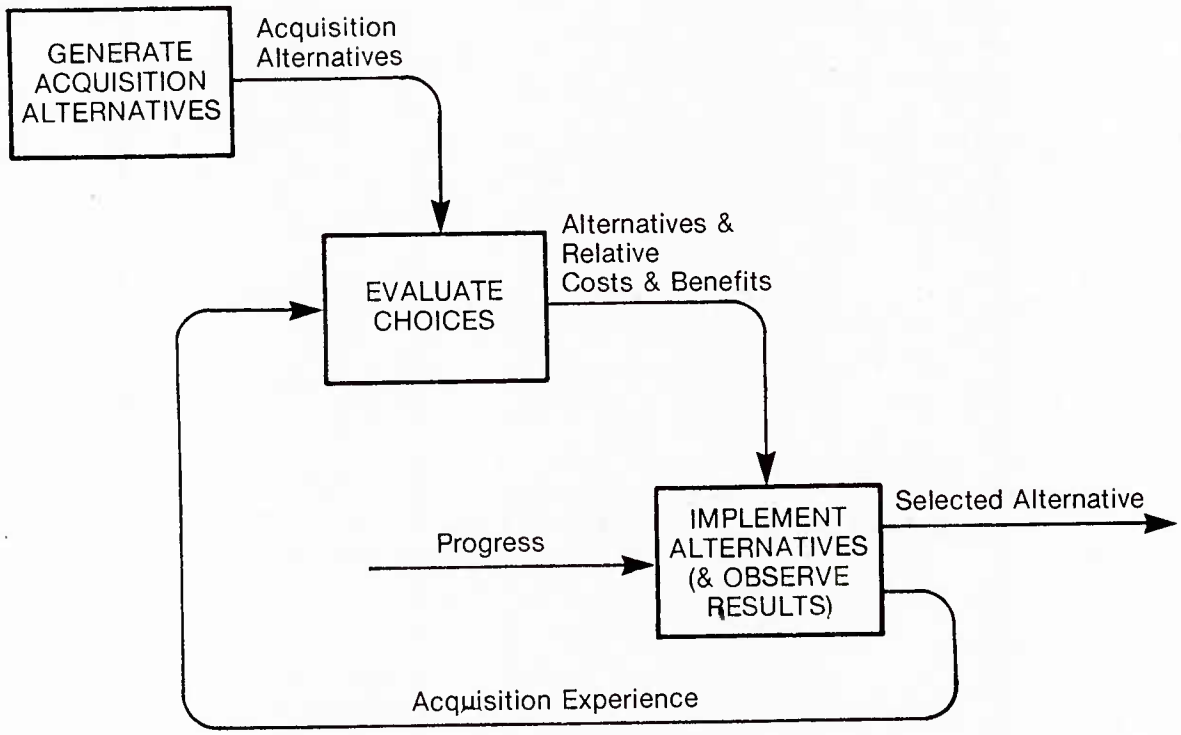


Figure 3.1 Impact Analysis During Initial Planning

element of acquisition planning that evaluates potential program or technical choices. Evaluation of choices occurs during initial planning or during execution of previously accepted plans. Impact Analysis is

discussed in sections 3.2.1.1 through 3.2.1.4.

- Due to a number of factors that arise in the course of a project, it may become necessary to effect changes to the various acquisition plans. For example, program plans may undergo changes at significant project review points. Change Management is the systematic, disciplined management of technical and program plan changes. This function is discussed in sections 3.2.1.5 and 3.2.1.6.
- Systematic Project Histories are a major source of insight for acquisition managers who are planning future acquisitions. These histories, periodically refreshed, are used in impact analysis. Histories are discussed in sections 3.2.1.7 and 3.2.1.8.

3.2.1.1 Impact Analysis During Initial Planning

Planning a project is driven largely by PMS-external guidance and direction, as shown in figure 3.2. This guidance and direction includes acquisition strategies as well as ship requirements based on threat and ship mission. Various acquisition alternatives must then be identified; impact analysis evaluates the effects of selecting each alternative. As shown in figure 3.3, the external guidance and direction determines the Acquisition strategy, as well as other philosophies and strategies, e.g., T&E, QA, ILS, and Configuration Management (box PMS/A12 in

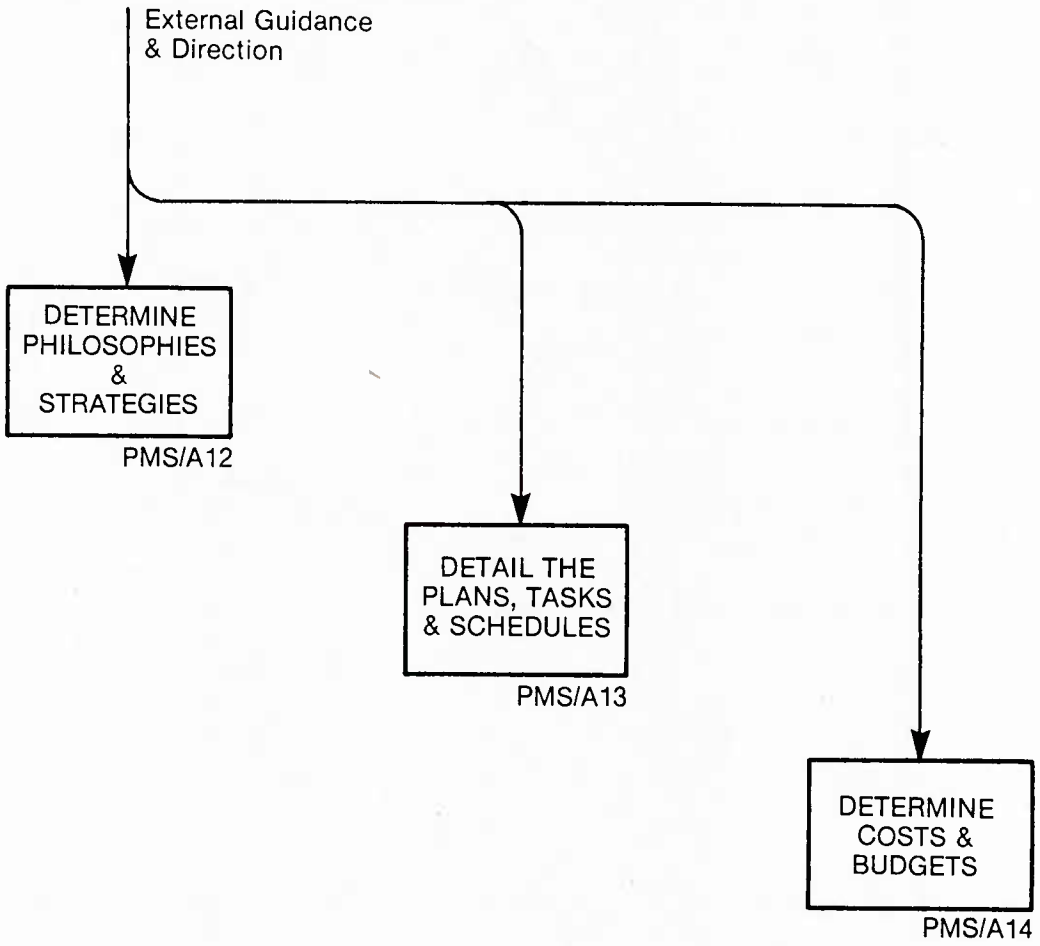

External Guidance
& Direction
DETERMINE
PHILOSOPHIES
&
STRATEGIES
PMS/A12
DETAIL THE
PLANS, TASKS
& SCHEDULES
PMS/A13
DETERMINE
COSTS &
BUDGETS
PMS/A14

Figure 3.2

the figure). The development of specific plans, tasks, and schedules follows (box PMS/A13). Costs are estimated and the total budget is compared to budget ceiling (box PMS/A14). Because the resulting costs and schedules may be unacceptable, alternative approaches with different plans, schedules, philosophies, or strategies may be developed and evaluated.

This entire process, done within each project during the initial planning phase, is inadequate for the Navy's needs as currently performed. Neither adequate statistics nor good modeling tools exist to reveal the impact of various alternatives on costs and schedules. No systematic means currently exist for bringing the Navy's cumulative experience to bear on this process, and the reliability of cost and schedule projections is limited to the breadth of experience of those creating and reviewing the projection.

The project planning phase also includes contributions from MAT08 and SEA90. Figure 3.4 shows this interaction. The proposed plans and strategies (produced by box PMS/A1 in that figure) are reviewed by SEA90 and MAT08. Lessons and experience compiled by MAT08 (MAT08/A24) and SEA90 (SEA90/A5) based on results of previous projects are used to develop guidance and direction on the proposed acquisition plan and may also lead to some alternatives (top arrow) to be considered by the PMS.

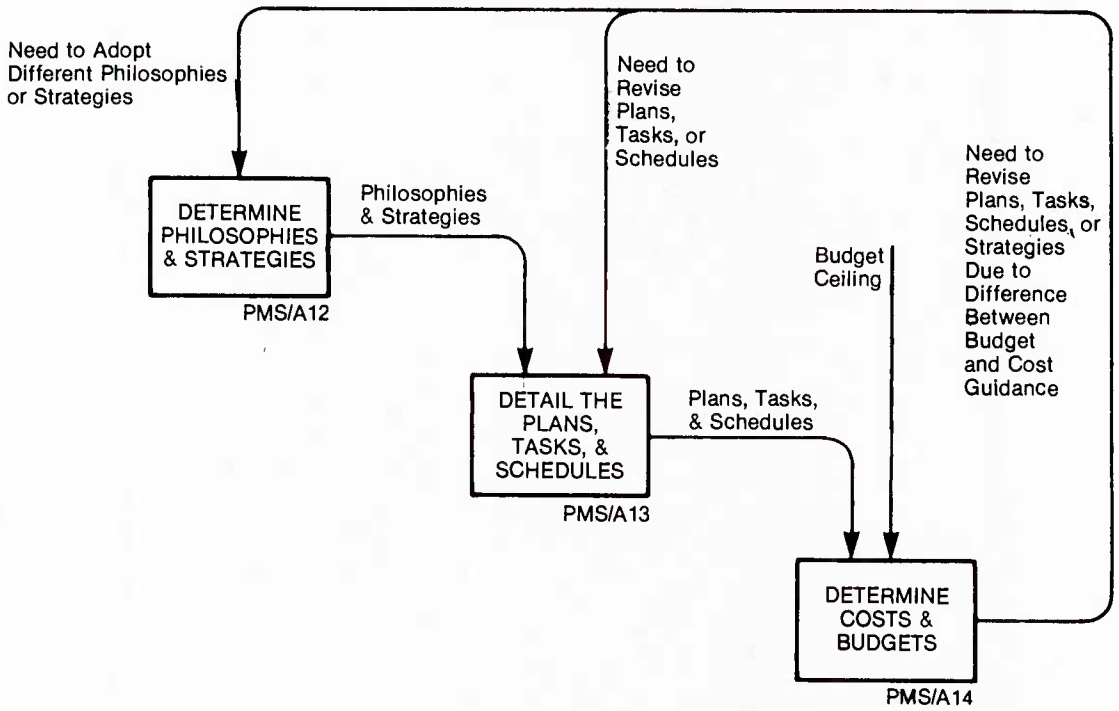


Figure 3.3 Impact Analysis During Ongoing Project

The main problem in this area is the lack of a systematic and comprehensive method for compiling experience. Status reports and ARB reports are maintained, but access

to useful information is difficult.

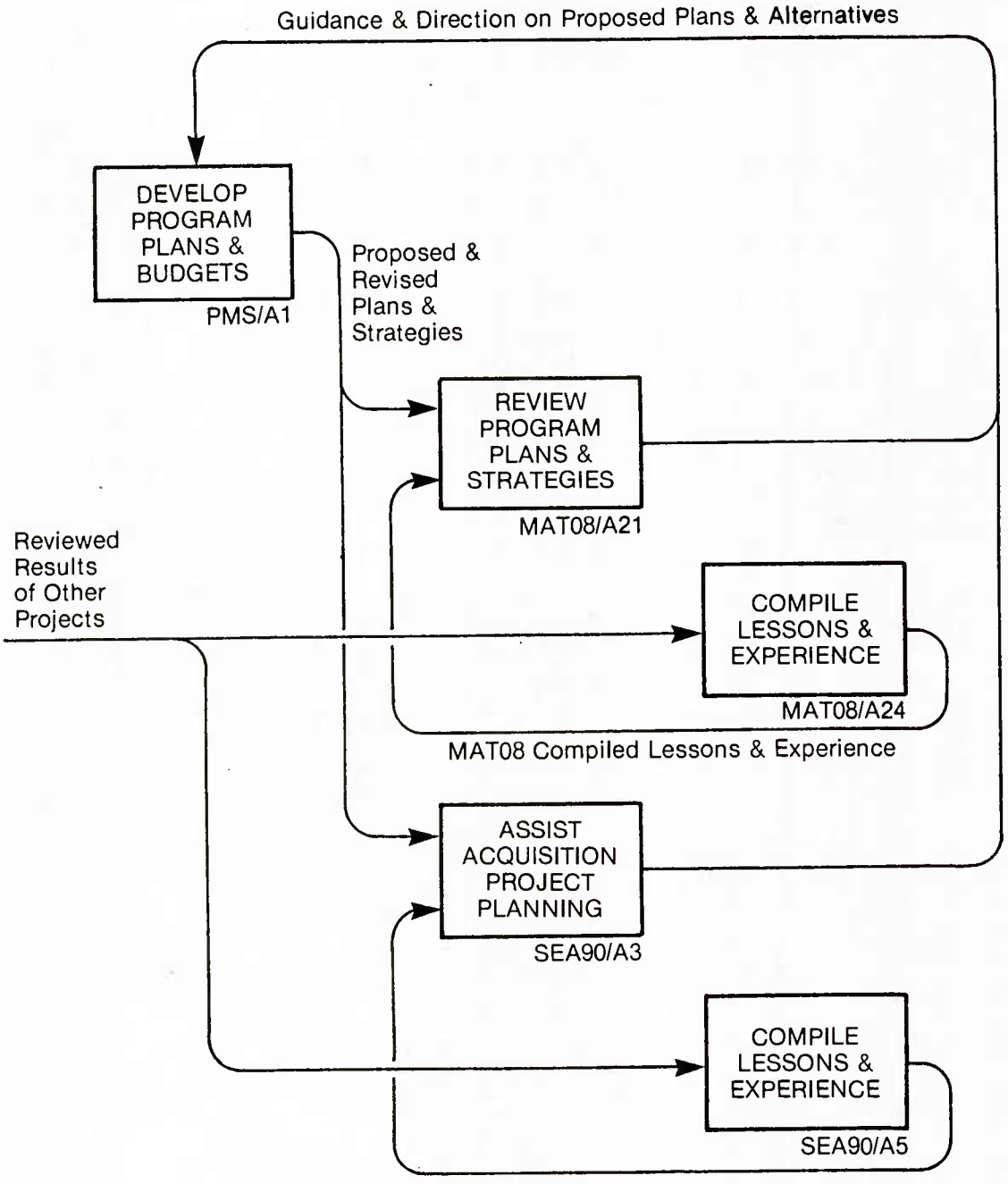


Figure 3.4

3.2.1.2 Impact Analysis During Ongoing Project

Figure 3.5 shows the functions and information associated with impact analysis as conducted within an ongoing project. The ongoing project produces progress reports (from box PROJ/A3) and technical documents (from box

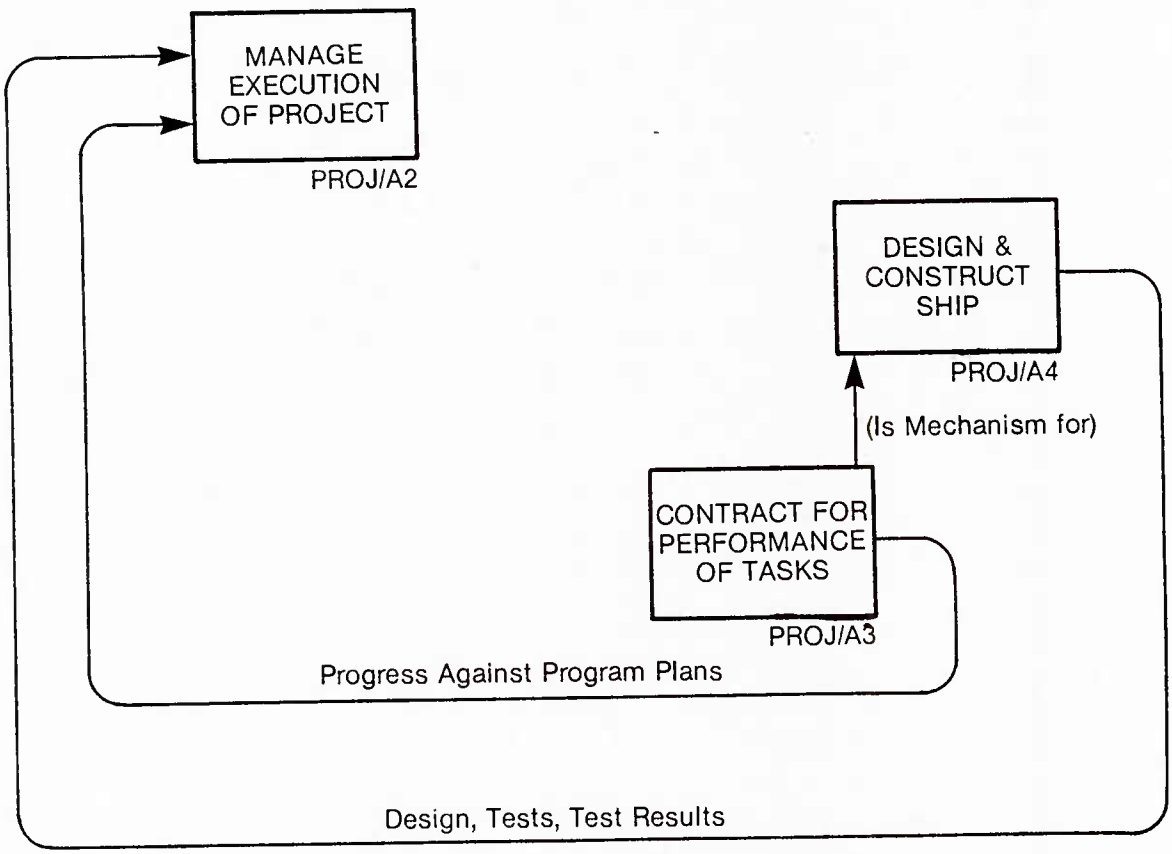


Figure 3.5

PROJ/A4). The technical documents include designs (engineering drawings and technical specifications), test results, and so forth. Progress reports (shown as

"progress against program plans" in the figure) contain information such as milestones achieved, costs incurred, cost and schedule variances, problems, and projections.

Inadequately developed designs or tests, unacceptable test results or unsatisfactory contract performance can lead a PMS to guide a contractor on technical matters or to initiate program and contract changes, as shown in figure 3.6. Programmatic/contractual changes are of two kinds: the first is contract modification (with contractors or shipbuilders) or redirection of tasking (with government technical support organizations); the second requires replanning, including the impact analysis described in the previous section (3.1.1.1).

The difficulties here are identical to those associated with impact analysis during initial planning: Project managers, SEA90, and MAT08 have no systematic means for bringing the Navy's collective experience to the project replanning process.

3.2.1.3 Impact Analysis Across Projects

The Navy currently assesses the impact of one project's technical and programmatic alternatives on other projects with difficulty because the project relationships are not formally understood and documented. Such was the case with the LHA and DD963 projects at Ingalls. Figure

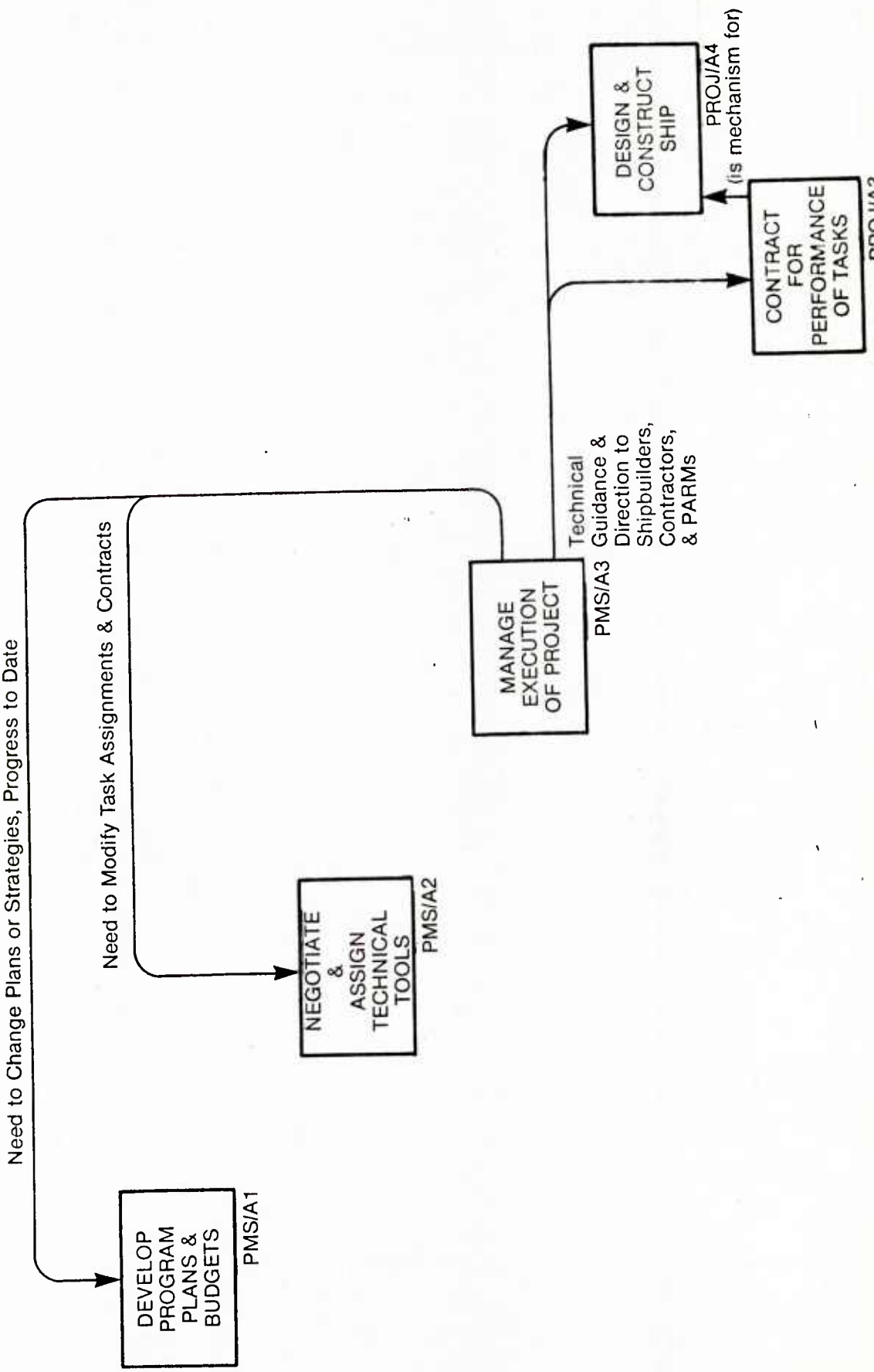

DEVELOP PROGRAM PLANS & BUDGETS
PMS/A1
NEGOTIATE & ASSIGN TECHNICAL TOOLS
PMS/A2
MANAGE EXECUTION OF PROJECT
PMS/A3
DESIGN & CONSTRUCT SHIP
CONTRACT FOR PERFORMANCE OF TASKS
PROJ/A3
PROJ/A4
(is mechanism for)
Technical Guidance & Direction to Shipbuilders, Contractors, & PARMs
Need to Change Plans or Strategies, Progress to Date
Need to Modify Task Assignments & Contracts

Figure 3.6

3.7 shows some of the functions and information involved in this complex task. MAT08, SEA90, and PARMs, participate in the Impact Analysis process, which evaluates an acquisition project alternative for its effect on other projects based on contention for resources such as shipbuilders and contractors.

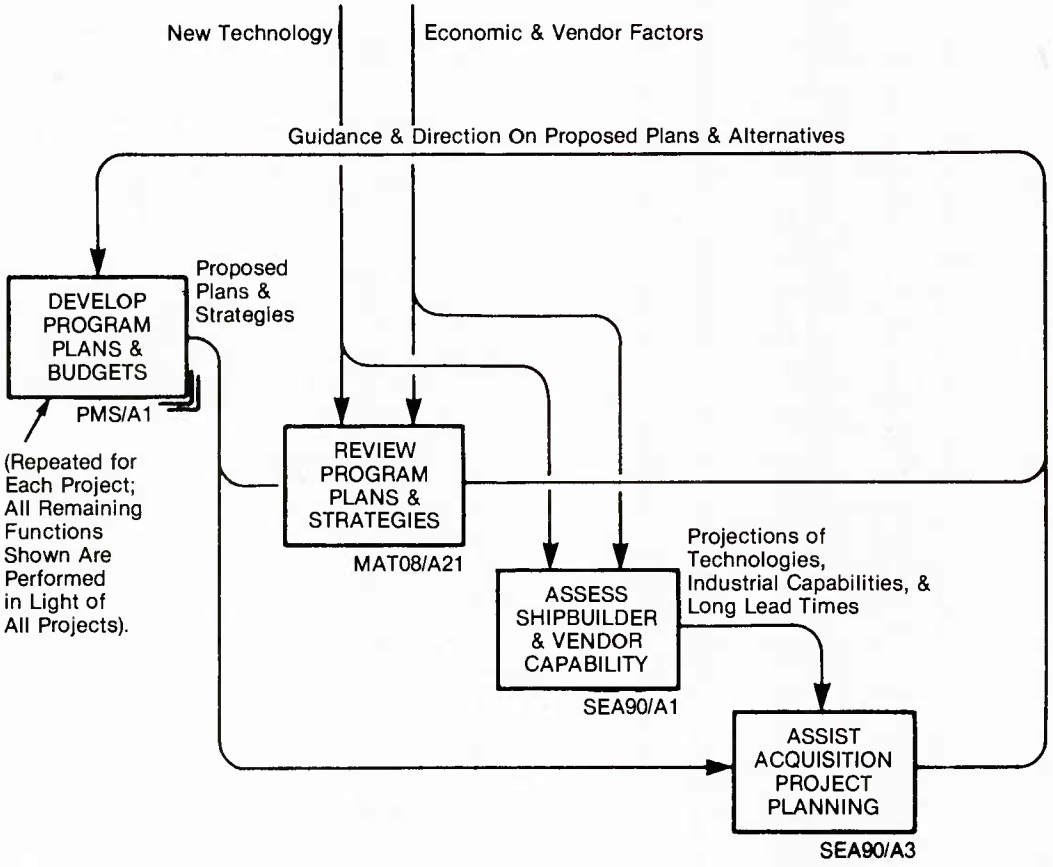


Figure 3.7

Interviews with MAT08 and SEA90 personnel revealed a desire for more powerful tools to facilitate the

development of guidance based on all projects extant or foreseen. The exact nature of the desired tools was not discovered, however. One project manager suggested that a Navy-wide catalog of contractor activities would help project planners recognize contractor activity patterns across projects. He believed that this catalog would prevent abuses and assist in multi-project impact analysis.

Government furnished equipment (GFE) provided by PARMs to several projects concurrently is another aspect of impact analysis. Proposed changes in design or delivery of ship systems can impact several projects, as shown in figure 3.8. At present, this impact is inadequately analyzed because, again, no systematic method exists to determine the impact of proposed changes on the design, cost, or schedule of all related projects. (This issue has a parallel in the discussion of change management.)

3.2.1.4 Impact Analysis Needs

We suggest three possible types of Impact Analysis to improve this functional area of acquisition planning:

a. Statistical based: This kind of impact analysis would be based on project histories and makes projections based on past performance across all projects or pro-

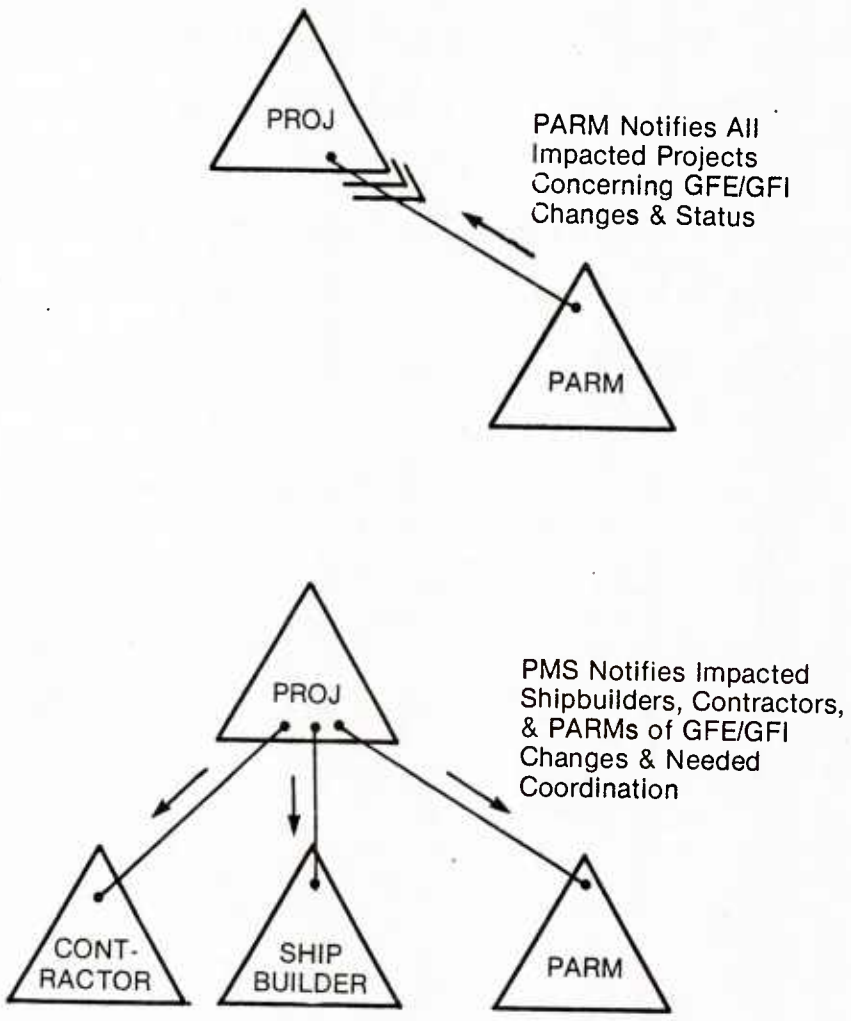


Figure 3.8

jects with some specific properties.

b. Model based: This kind of impact analysis would require development of a number of models relating the variables in question. Some of these models are quite simple, such as the model relating incremental cost to schedule change, manpower loading rate and cost, and inflation. Others are somewhat more complex but

well-defined, such as critical path models --like PROMAP and TRANSIM-- that can be used to determine program schedule changes associated with task schedule changes. Finally, there are highly complex analyses for which reliable and accurate models have yet to be completely formulated. The cost estimating model currently being developed by TASC for the Acquisition Review Council is in this category.

c. Case history: This kind of impact analysis would require project histories that contain information about key project characteristics and experiences. This information, which need not have pre-defined format or classification, could help answer "what if ..." questions with "what happened when ..." answers. This kind of impact analysis requires further definition of the type of information needed.

Key issues to be answered include:

- The nature of project histories, and definition of their contents
- Access rights to project histories
- Access rights to specific analysis tools
- The nature of required "Lessons Learned", definition of contents, information source, access rights.

A thorough requirements analysis in these areas should be conducted.

3.2.1.5 Change Management

Change management involves selecting from among alternative plans and effecting the change by communicating it to interested or affected parties. Change management includes both technical and programmatic changes. Figure 3.9 shows highlights of the change management function. Based on an impact analysis, a proposed engineering or programmatic change may require modifying or negotiating a contract with a shipbuilder or contractor, or modifying or negotiating an agreement with a PARM or other government activity for technical support. Based on the proposal or estimate (input to box PMS/A2), programmatic or engineering changes are negotiated (lower output of PMS/A2). The task plans and budgets must be modified (upper output of box PMS/A2) to insure accurate progress reporting (PROJ/A3 to PMS/A3) and the engineering change (if any) must be recorded (output of box PMS/A3).

From an information management viewpoint, change management includes four information recording or communicating activities:

a. Record the engineering change, if any;
b. Communicate the engineering changes to appropriate PARMs, shipbuilders, etc.;
c. Record the program plan changes;
d. Communicate the program plan changes to appropriate PARMs, shipbuilders, etc.

Engineering changes are currently recorded after ECP's

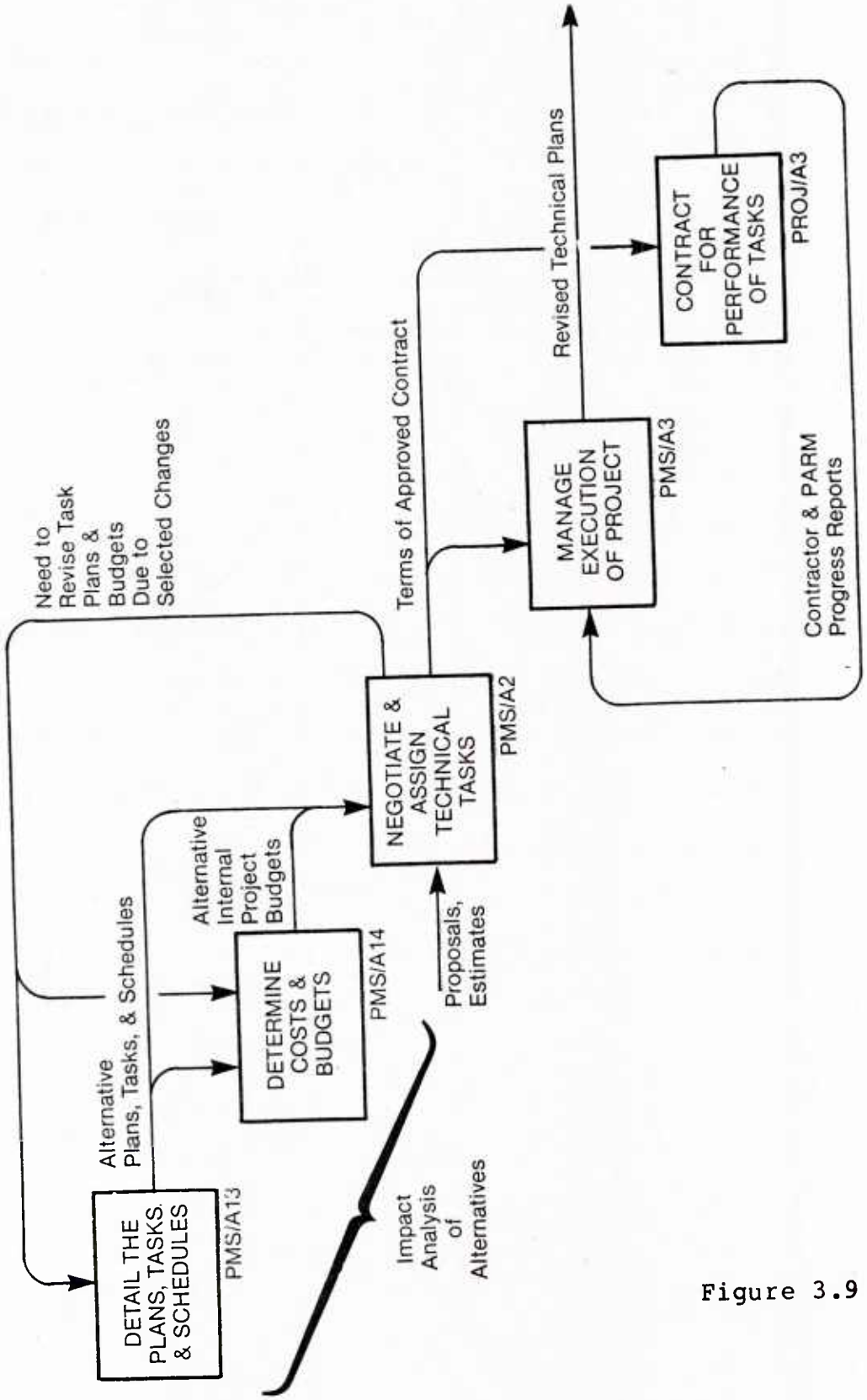

DETAIL THE PLANS, TASKS, & SCHEDULES
PMS/A13
DETERMINE COSTS & BUDGETS
PMS/A14
NEGOTIATE & ASSIGN TECHNICAL TASKS
PMS/A2
MANAGE EXECUTION OF PROJECT
PMS/A3
CONTRACT FOR PERFORMANCE OF TASKS
PROJ/A3
Alternative Plans, Tasks, & Schedules
Alternative Internal Project Budgets
Proposals, Estimates
Impact Analysis of Alternatives
Need to Revise Task Plans & Budgets Due to Selected Changes
Terms of Approved Contract
Revised Technical Plans
Contractor & PARM Progress Reports

Figure 3.9

have been approved, but the manner in which this is done varies from project to project. Further, access to this change information is difficult. It is not clear how well these records are organized and maintained, but interview respondents noted that poor maintenance of these records leads to difficulty in claims management, a known problem. Recording program plan changes also appears to be an area of difficulty. No systematic means for updating the plans was discovered during the interviews. By implication, financial management becomes less reliable.

The final area of difficulty in change management, and perhaps the most significant, is communication of changes among impacted parties. One situation discussed during the interviews concerned GFE provided by a PARM: If a PARM must make an engineering change to some ship system, the impacted PM, shipbuilder, and related contractors (and perhaps other PARMs) must be notified of the change. This was illustrated earlier in figure 3.8. Interview respondents noted that communication of engineering or program change among the impacted parties is currently inadequate.

3.2.1.6 Change Management Needs

We suggest that further detailed analysis be conducted in the following areas of recommended improvement:

1. The original program plan should be recorded in a form that will allow direct transcription of approved changes.
2. The program plan should be revised directly from any formal impact analysis, if performed, or should be revised as needed for situations not worthy of a formal impact analysis. This procedure will preclude delays and transcription errors.
3. The engineering changes should be recorded. They cannot be used, however, to revise the technical plans until technical plans are recorded in a form allowing direct transcription of technical drawings and specifications.
4. Program plans, as modified, and engineering changes should be transmitted to interested parties, and such communication should cause revision of the recipient's records (as in (1) and (3)).

We also suggest that a detailed analysis be conducted to determine how the change management process updates the project histories.

3.2.1.7 Systematic Project Histories

Systematic Project Histories involve establishing and maintaining a "corporate memory" -- a source of information containing acquisition project experience. This data can be used to facilitate both Impact Analysis and Change Management. The high ranking that interview respondents gave to improvement in this area indicates their awareness of its vital nature. However, there was not universal agreement as to the desirable contents or use of such histories; neither was there agreement on responsibility for maintaining them.

At present, Project Histories are not systematically maintained: Lessons learned are lost and different projects work from different fact bases, making the Navy appear inconsistent and unreliable.

3.2.1.8 Systematic Project History Needs

The key to defining project histories is understanding their use: Project histories cannot be studied independently, but must be studied in the context of impact analysis and change management. We suggest further requirements analysis, therefore, to define the nature, content, and use of project histories, particularly in the

following areas:

1. How are histories used to aid inter-project and intra-project impact analysis? What specific information needs of impact analysis can be satisfied by project histories?
2. How are histories refreshed to include progress and experiences?
3. How are these histories used by MAT08, SEA90, and PMs? Are the components of histories private to projects?

3.2.2 Cost Estimating

Developing cost estimates is a difficult and time consuming procedure. Inaccurate cost estimating has led to management difficulty and lack of Navy credibility, particularly during Congressional hearings. It is not surprising, then, that cost estimating support was ranked high in desirability by interview respondents.

To develop a reasonable cost estimate, several different cost estimating methods -- including bottom up and top down -- are used by different organizations; these estimates generally do not agree, but should be close. Estimates made by the same method, but based on different underlying assumptions, may also disagree. Thus, it can be misleading or confusing to present a cost estimate without its underlying assumptions or its calculation method.

There are two aspects of cost estimating that must be considered. One is the cost estimating process itself; this is a computational and modeling problem that is the subject of another Acquisition Research Council effort. The other is the recording of the cost estimate together with its basis for calculation; this is an information management issue.

A major weakness in current practice seems to be a lack of systematically maintained, easily accessed record of individual cost estimates with their attendant basis for calculation, as shown in figure 3.10. Interview respondents ranked improvement in this area highly. Further study may show that cost estimate recording can be included as part of the methodology developed for maintaining Systematic Project Histories.

3.2.2.1 Cost Estimating Needs

If cost estimating memory is to be supported, several issues related to cost estimates and the basis for calculation must be resolved in the next phase of this project:

a. Identify the basis of calculation of cost estimates. At least the following must be considered:
   - What input data was used?
   - What assumptions are made (e.g., acquisition alter-

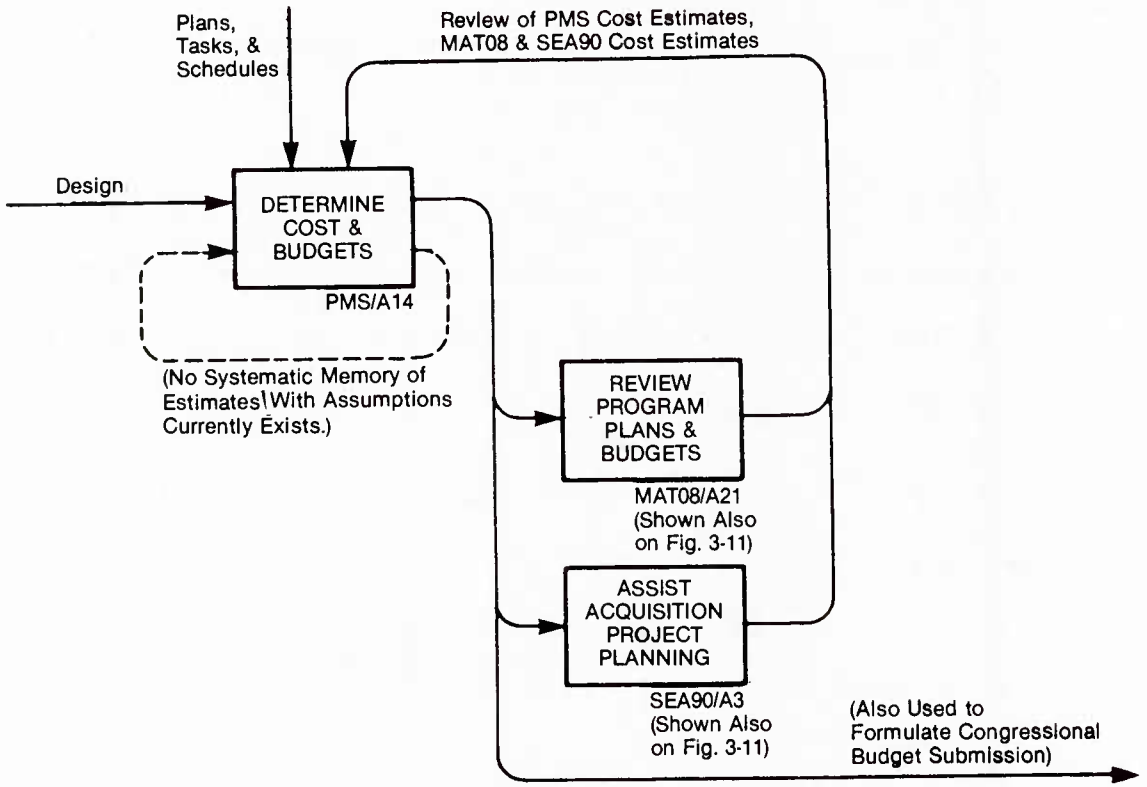


Figure 3.10

natives, labor situations, inflation rate)?

- Which algorithm or technique was used to compute the estimate?
- What experience is reflected in this estimate, i.e., what components of project histories influenced the estimate?
- What previous estimates were considered or were the starting point for this estimate?

b. Define the access rights to these estimates and assumptions: Are estimates and assumptions for project use only (as shown in figure 3.11) or are they to be included in collective Navy experience (see figure 3.12) for use on all projects? The latter is desirable but poses privacy problems.

c. Determine whether and when the estimates and assumptions become a component of private or public project histories. Are working estimates recorded in private histories?

d. Define the storage life of the estimates and assumptions and determine whether these should be stored in full. If older estimates with assumptions are stored in synopsized form, determine when summarizing occurs.

e. Define the relationship that exists between the most recent estimates and project plans and financial management (to be discussed in section 3.2.4).

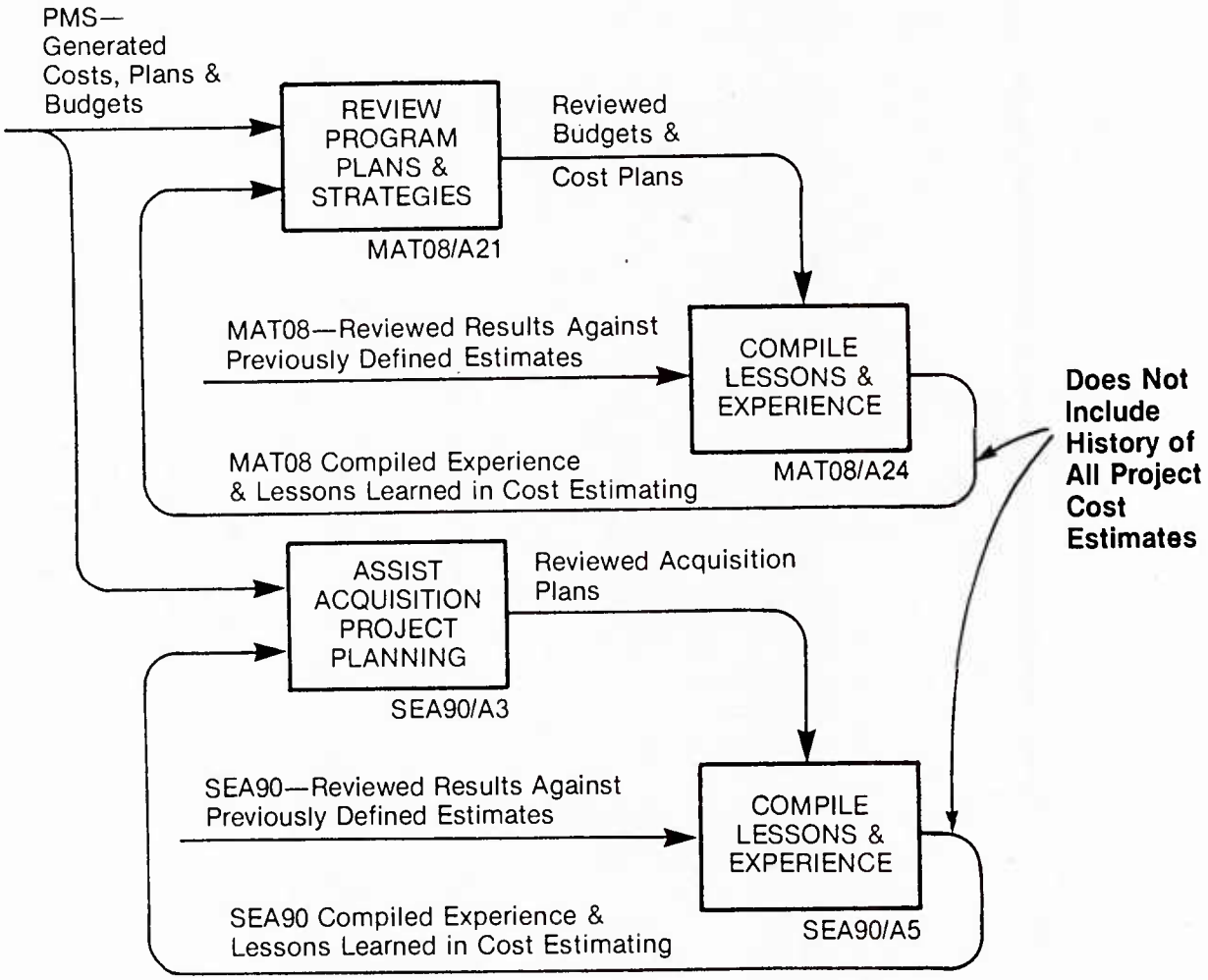

PMS—
Generated
Costs, Plans &
Budgets
REVIEW
PROGRAM
PLANS &
STRATEGIES
MAT08/A21
Reviewed
Budgets &
Cost Plans
MAT08—Reviewed Results Against
Previously Defined Estimates
COMPILE
LESSONS &
EXPERIENCE
MAT08/A24
MAT08 Compiled Experience
& Lessons Learned in Cost Estimating
Does Not
Include
History of
All Project
Cost
Estimates
ASSIST
ACQUISITION
PROJECT
PLANNING
SEA90/A3
Reviewed Acquisition
Plans
SEA90—Reviewed Results Against
Previously Defined Estimates
COMPILE
LESSONS &
EXPERIENCE
SEA90/A5
SEA90 Compiled Experience &
Lessons Learned in Cost Estimating

Figure 3.11

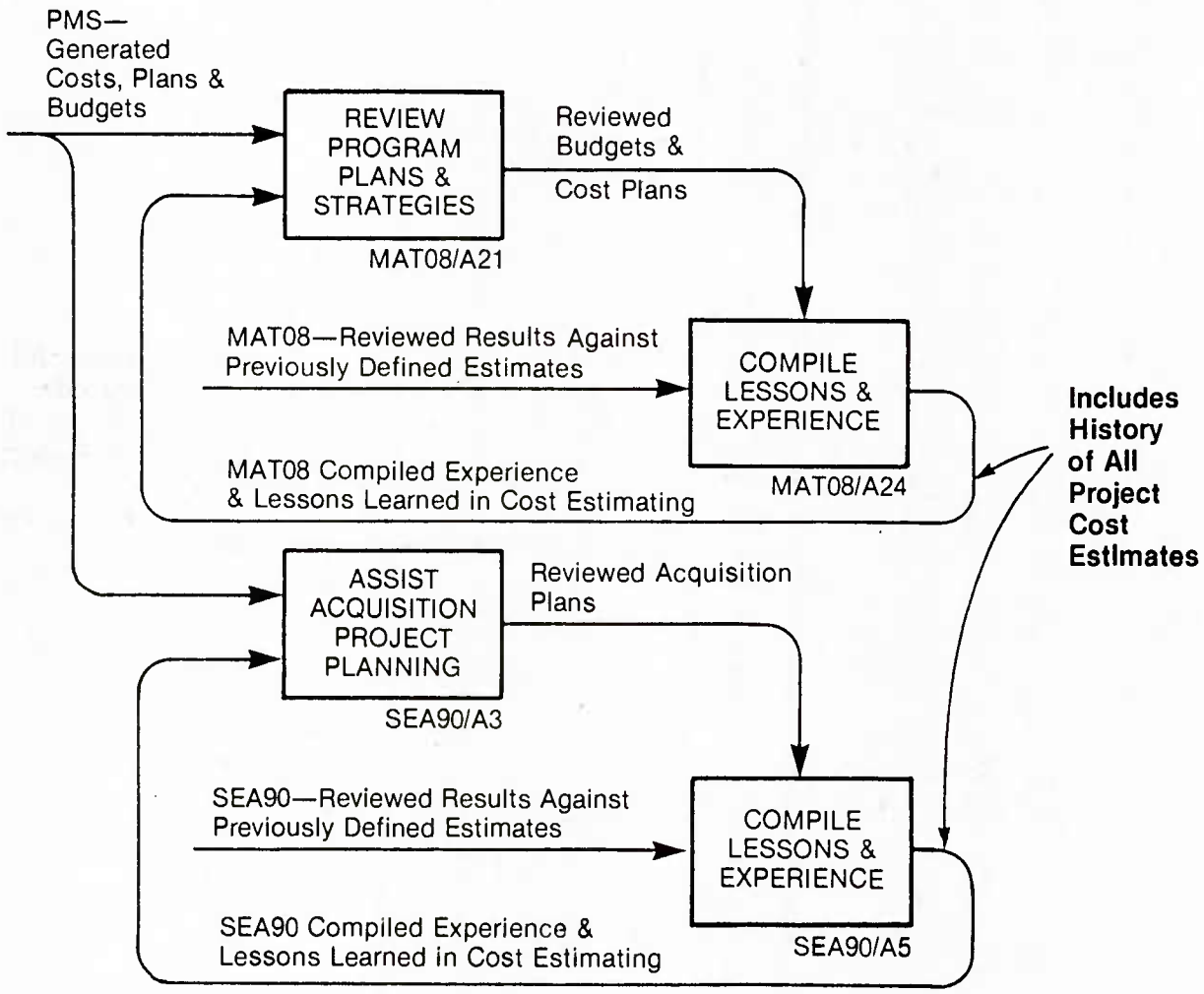

PMS—
Generated
Costs, Plans &
Budgets
REVIEW
PROGRAM
PLANS &
STRATEGIES
MAT08/A21
Reviewed
Budgets &
Cost Plans
MAT08—Reviewed Results Against
Previously Defined Estimates
COMPILE
LESSONS &
EXPERIENCE
MAT08/A24
MAT08 Compiled Experience
& Lessons Learned in Cost Estimating
Includes
History
of All
Project
Cost
Estimates
ASSIST
ACQUISITION
PROJECT
PLANNING
SEA90/A3
Reviewed Acquisition
Plans
SEA90—Reviewed Results Against
Previously Defined Estimates
COMPILE
LESSONS &
EXPERIENCE
SEA90/A5
SEA90 Compiled Experience &
Lessons Learned in Cost Estimating

Figure 3.12

3.2.3 GFE/GFI Management

GFE/GFI Management involves maintaining an accurate record of GFE/GFI status and acting to assure timely and complete delivery of undamaged GFE and accurate GFI. Acquisition managers interviewed mentioned two general problem areas, GFE/GFI change management and GFE/GFI status reporting.

GFE/GFI change management includes identifying changes in GFE/GFI (figure 3.13), identifying the impacts on associated projects, and implementing any changes (figure 3.14). This kind of impact analysis and change management is covered in section 3.2.1.

There are two facets to the GFE/GFI status reporting and recording problem. From an information management viewpoint, the problem is one of determining the nature of the information that is transmitted among the PARMs, PMs, shipbuilders, and contractors. From a communications viewpoint, the information transmitted is unimportant: The issue is one of notification.

Further study is required to determine the significance of each of these aspects. This area was ranked by interview respondents somewhat lower than the previously discussed areas, however.

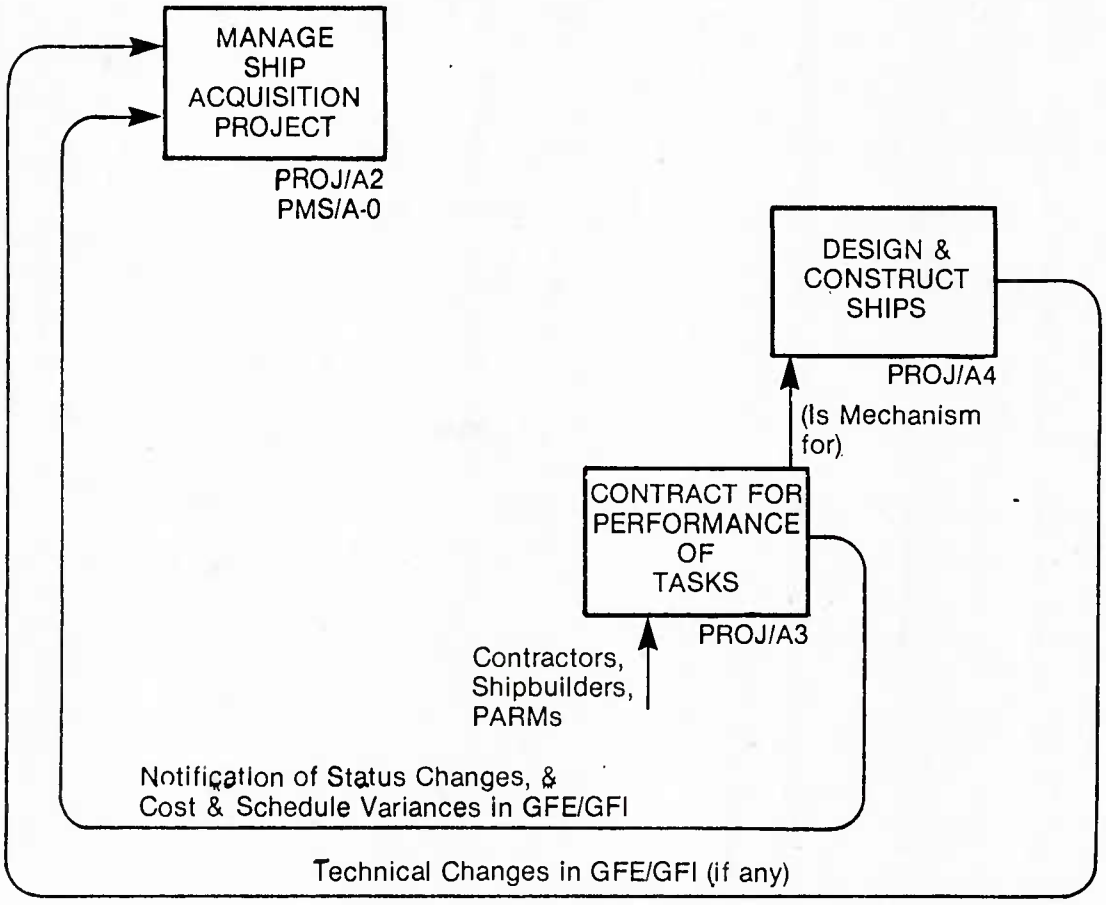


Figure 3.13

3.2.4 Project Financial Management

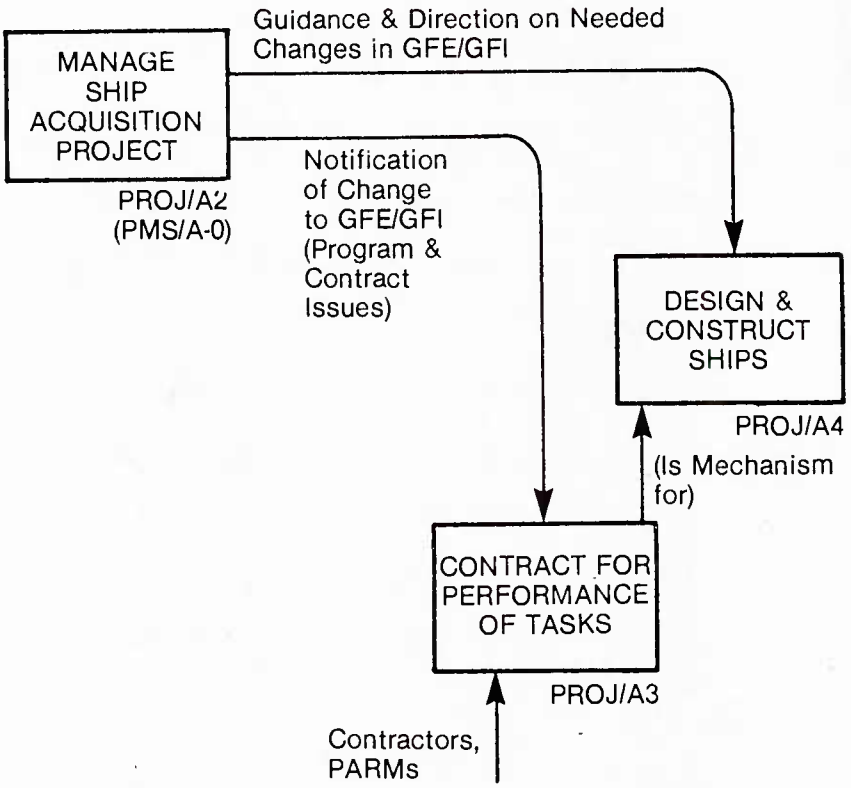


Figure 3.14

3.2.4.1 Financial Management Functions

Two of the essential elements of classical management are maintaining accurate budgets, journals and ledgers, and preparing appropriate financial reports. In current practice, each acquisition project tends to develop, at considerable cost, its own unique system of financial

management. These systems have many elements of financial management in common.

Figure 3.15 illustrates the major functions and internal information associated with project financial management. Internal project budgets are developed (PMS/A14 in the figure) based on plans and schedules previously developed (by PMS/A13). These internal budgets, the basis for the Congressional Budget submissions, are used with the plans to negotiate and approve any contracts (PMS/A2). The contract is issued, and performance on the contract is reported by the shipbuilder or contractor (PROJ/A3) Based on these reports, particularly cost and schedule variance, the PMS may determine a need to redirect a contractor, modify a contract, and/or revise the plans and budgets. Interaction with PARMs is similar to the interaction with shipbuilders or contractors.

The information mentioned in the financial management process falls into three categories. One category is working information of long term interest, including:

1. plans, tasks, and schedules,
2. internal budgets and obligation plans, and
3. terms of approved contracts.

The most recent versions of these are maintained in accessible form while old versions are part of history.

The second category is information of immediate interest when published, and of historical value after

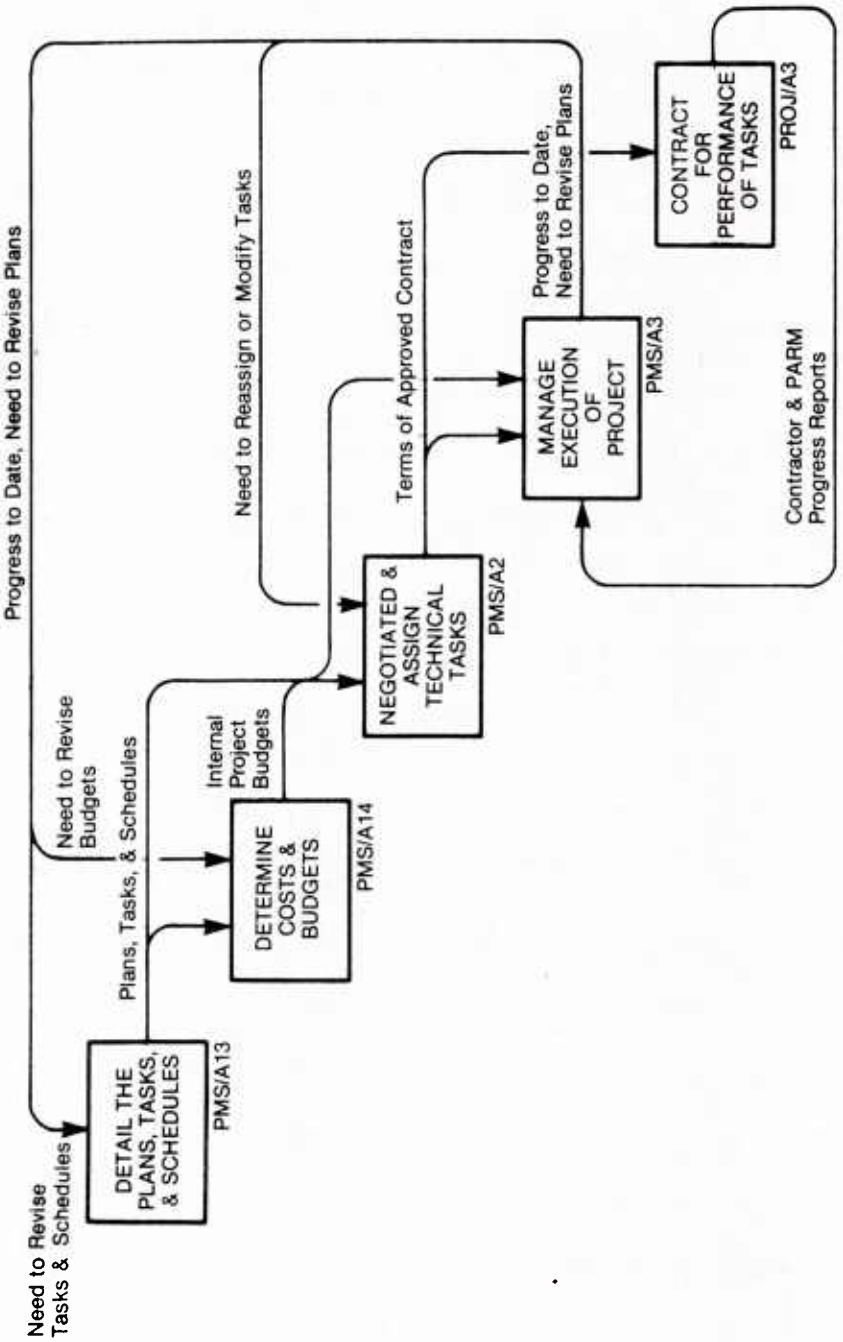

Need to Revise Tasks & Schedules
DETAIL THE PLANS, TASKS, & SCHEDULES
PMS/A13
Plans, Tasks, & Schedules
Need to Revise Budgets
DETERMINE COSTS & BUDGETS
PMS/A14
Internal Project Budgets
NEGOTIATED & ASSIGN TECHNICAL TASKS
PMS/A2
Terms of Approved Contract
MANAGE EXECUTION OF PROJECT
PMS/A3
Progress to Date, Need to Revise Plans
CONTRACT FOR PERFORMANCE OF TASKS
PROJ/A3
Contractor & PARM Progress Reports
Need to Reassign or Modify Tasks
Progress to Date, Need to Revise Plans

Figure 3.15

that, including:

1. contractor, shipbuilder, and PARM status reports, and
2. internal project status, which may be used to develop external status reports (e.g., NSATS, SAR).

The third category of information is of a transitory nature although of high interest, including:

1. need to revise plans, schedules, and budgets, and magnitude of needed change, and
2. need to modify contracts with shipbuilders/contractors or agreements with PARMs, and magnitude of needed change.

These are generally mental notes and are of a transitory nature.

External status reporting, illustrated in figure 3.16, makes use of information in the first two categories mentioned above. Project status reports are developed (PMS/A3 in the figure) based on budgets, plans, schedules, and progress reports from contractors, shipbuilders, and PARMs. These are reviewed by MAT08 (MAT08/A23) and SEA90 (SEA90/A4). Project status reports currently are produced in several forms, including NSATS and SAR.

In discussing the needs associated with the recording and reporting of financial data, interview respondents identified two needs but valued them differently. High value was placed on improvement in change management of plans and budgets associated with financial management.

Improvement in recording and reporting of actual costs and progress was not valued highly, although respondents noted that developing NSATS and SAR reports from these actual data was a time consuming effort.

3.2.4.2 Financial Management Needs

Requirements analysis should proceed in several areas if this function is selected for further study.

In the area of general ledgers, journals, and budgets, at least three issues must be addressed:

1. What relationship exists between the budget and any plans? How does the change management function, with influence over plans, also revise the budget and schedules, if at all?
2. Do budgets, journals, and ledgers have predefinable characteristics that may change from project to project?
3. How are the budgets structured and related to general ledgers and journals so that progress reports can be reliably and accurately produced?

With regard to reporting, two areas of need should be studied:

1. If budgets and schedules are not revised by change management functions, how are status reports produced showing progress against the most recent plans and

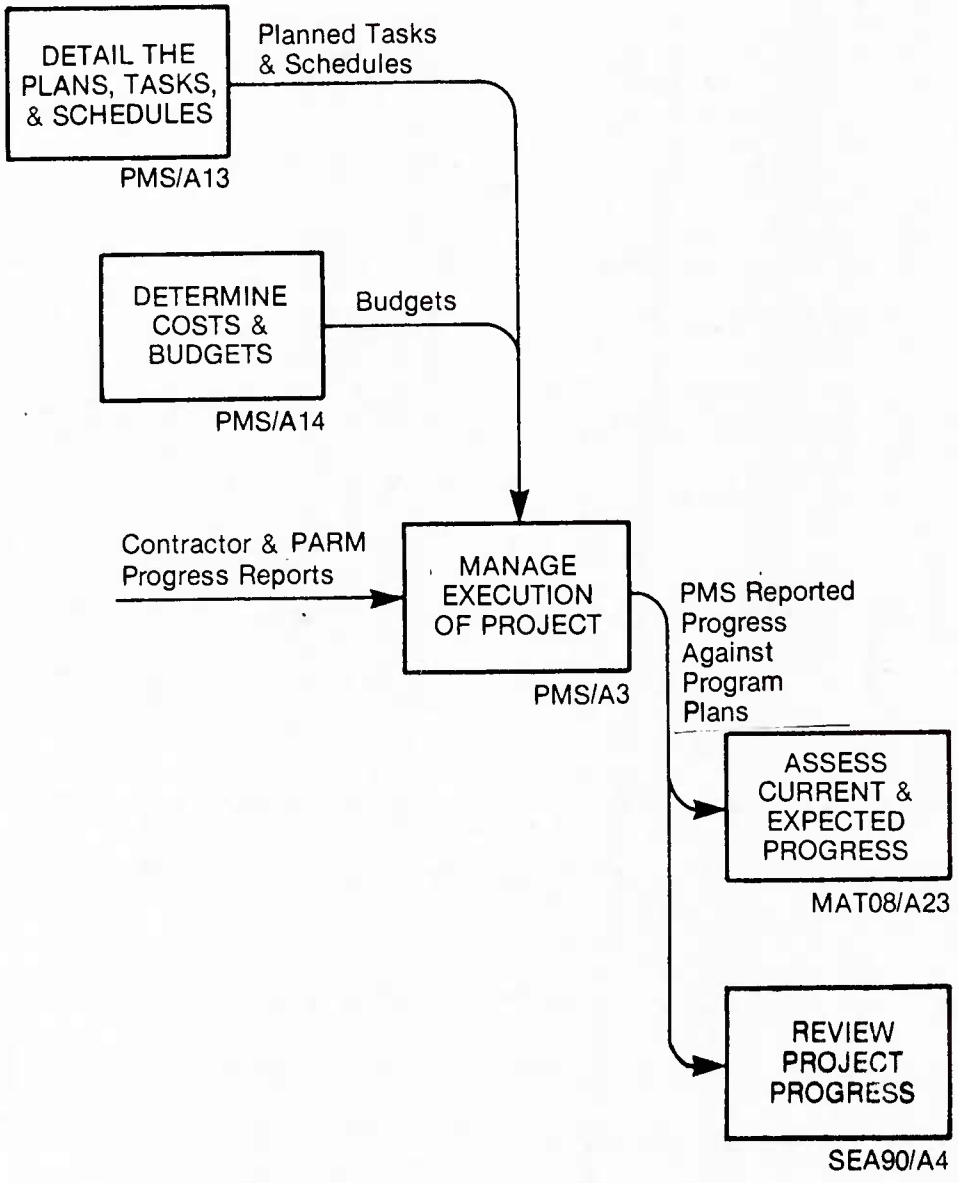

DETAIL THE PLANS, TASKS, & SCHEDULES
PMS/A13
Planned Tasks & Schedules
DETERMINE COSTS & BUDGETS
PMS/A14
Budgets
Contractor & PARM Progress Reports
MANAGE EXECUTION OF PROJECT
PMS/A3
PMS Reported Progress Against Program Plans
ASSESS CURRENT & EXPECTED PROGRESS
MAT08/A23
REVIEW PROJECT PROGRESS
SEA90/A4

Figure 3.16

budgets?

2. How are NSATS, SAR, and other project progress reports developed? Can some sections be calculated automatically while other sections remain manually created?

Further study is also needed to determine whether progress reports are to be stored as part of project histories, and if so, what use is made of them. Specifically, the relationship between storage and production of progress reports and development of "lesson learned" must be determined. Figure 3.17 illustrates the transformation. (This area overlaps study required to understand the need for project histories.)

3.2.5 Preparing and Disseminating Various Management Plans

The interview respondents expressed a concern about the amount of labor expended to prepare, revise, review, and distribute the programmatic documents involved in ship acquisition. This was mentioned as an area contributing to excessive costs and delays in the acquisition process.

Although interview respondents did not give high priority to support for this function, the use of more contemporary information management and word processing methods would significantly enhance this function. If the Navy desires further effort in this area, we recommend

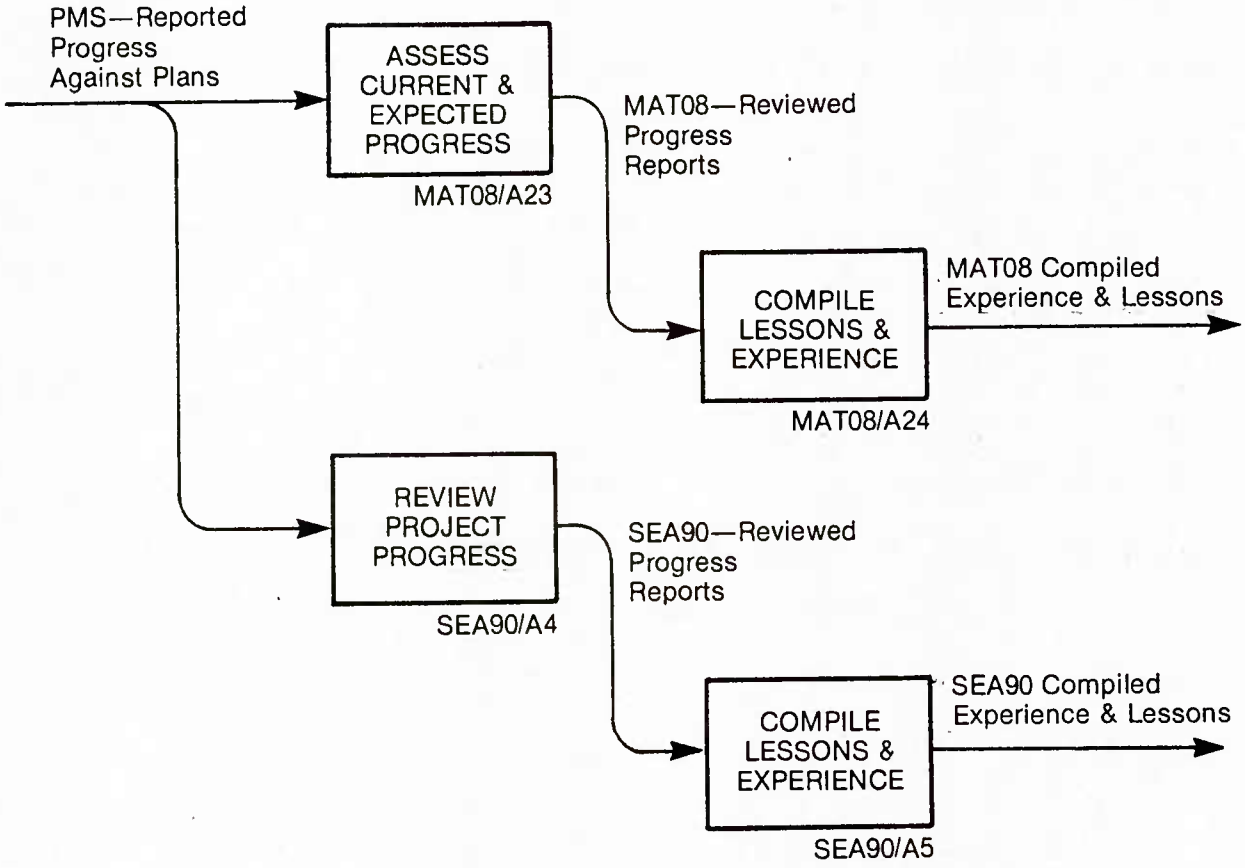


Figure 3.17

analysis to determine the relationship between this function and change management. Specifically, several questions should be addressed:

1. Which plans maintained and refreshed by change management are presented in formal documents?
2. Which plans are maintained as text, and which are tabular, graphic, or otherwise machine interpretable?
3. What relationship exists between tabular or graphic

format plans, which may be regularly maintained, and textual documents published periodically incorporating the latest tabular or graphic plans?

4. What document version control support is required to keep track of documents and the state of the plans that comprise them?

3.2.6 Project Problem Management

There is general recognition that the typical acquisition manager and his staff spend a substantial portion of their time managing problems. These can be technical or programmatic, but almost always involve:

1. defining the problem
2. correlating the problem with other problems
3. analyzing the problem
4. generating a corrective action
5. implementing the corrective action
6. verifying that the problem is solved.

At any given time, an acquisition project may have hundreds of problems in various of the above stages, with a number of outside organizations involved.

Clearly, a systematic discipline for problem management is indispensable. Yet project managers who were interviewed did not apparently have a common discipline or support system, nor did they give high priority to developing support for this area. Detailed requirements

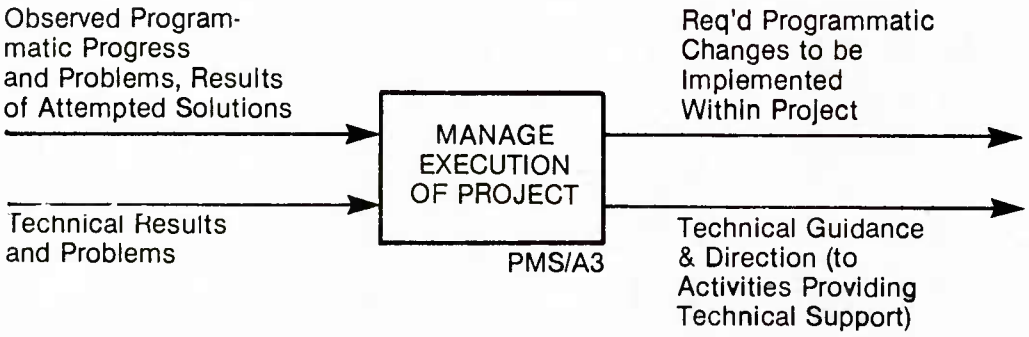


Figure 3.18

analysis in this area would determine which of the above six steps required support, if the Navy believes this area deserves further study.

3.2.7 Contracts Administration and Personnel Administration

There was general agreement that Contract Administration (such as performed by NAVSEA 002) and Personnel Administration (such as performed by NAVSEA 02) are functions that contribute greatly to delays and increased costs in the acquisition process because of their inability to respond in timely fashion. But there was no consensus on how to solve these problems, nor was there any indication that solving them was possible within the scope

of this project. No further study in this area is recommended for this project.

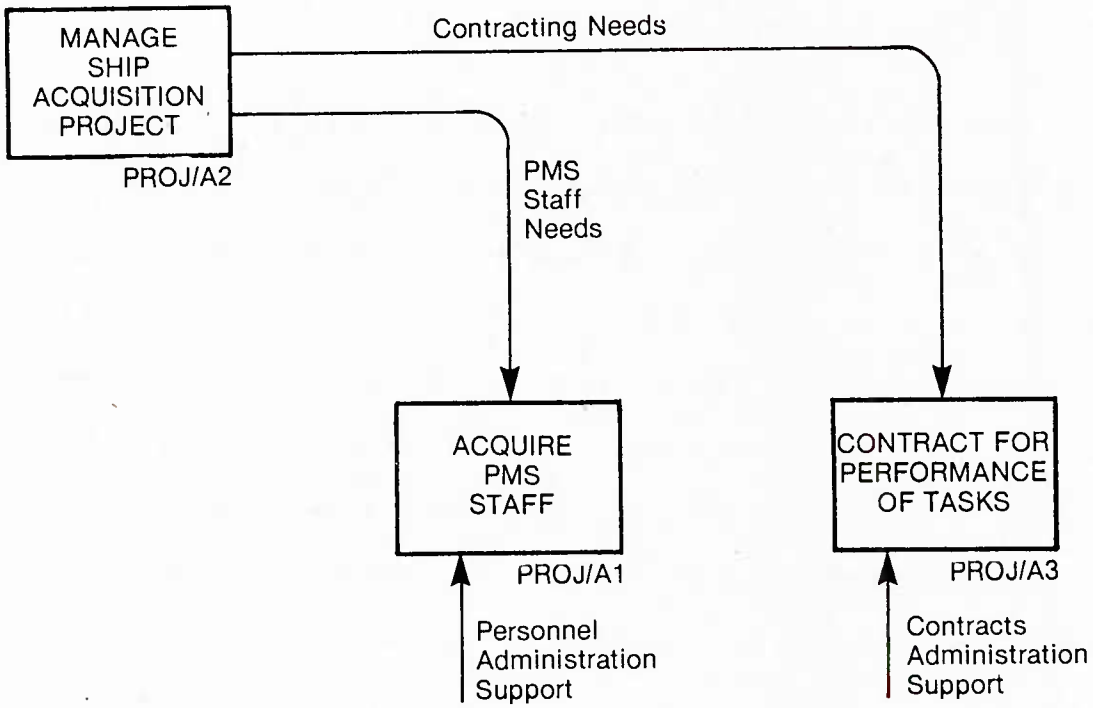


Figure 3.19

3.3 Design and Implementation Considerations

As indicated in section 3.1, several interview respondents raised concerns about how information management tools should be implemented within the functional areas discussed in section 3.2.

One concern commonly identified by interview respondents was that any acquisition support tools must insure the privacy and security of the user's acquisition data. Respondents were concerned that unrestricted access to confidential, private, or working information by those unfamiliar with its content or meaning could lead to embarrassment or confusion -- loss of effectiveness in managing one's project, in short. Privacy and security is therefore a critical requirement in the design of any information tools that can facilitate information sharing. We recommend that any further analysis determine the privacy/security needs for all information associated with functions selected for detailed requirements analysis.

Another attitude commonly encountered was the reluctance of well-established acquisition project organizations to accept changes to the way information is currently handled because changes are seen as disruptive to existing practices. Newly established acquisition project organizations, on the other hand, seem to be more receptive to improved information management. This attitude difference must be considered when choosing

organizations at which to implement information tools developed by this project.

[flush this text]

4. Recommendations

The objective of this phase of the project is to define the scope of the Acquisition Support Tools requirements analysis. The major product of this phase, then, is definition of specific targets for automated support.

Collectively, the interview respondents identified the major concerns detailed in section 3, specified the value of supporting the areas of concern, and described their receptivity to automated solutions for those problems. One finding was that well-established acquisition projects are reluctant to change current methods of information management. One implication of this finding is that tools implemented to directly support established project management would not necessarily be widely accepted.

There was widespread agreement regarding another finding. Decisions made in the early stages of an acquisition (prior to DSARC Milestone I) are generally the most significant ones - by virtue of their impact made during the lifetime of an acquisition. The value of support in acquisition planning was therefore rated as high, and such support could most likely be welcomed as non-disruptive. Support for other functions not presently well supported (manually or automatically) would also be

seen as beneficial.

The major recommendation of this effort, therefore, is that development of automated support should focus on the acquisition planning function, including impact analysis, change management and systematic project histories. The relevant information of interest must be defined and its usefulness documented. The requirements analysis should continue to develop detail within the framework already documented here.

The CCA/ROH project team looks forward to Navy concurrence and comment on this recommendation.

5. Some Designs to Satisfy Acquisition Needs

5.1 Introduction

Previous sections of this scoping document deal with acquisition management issues, with little regard for preconceived system designs that could influence discovery of acquisition management needs. Having documented a general understanding of the requirements however, a look at the available technology can be useful: understanding the potential for automated support can open the discussion to acquisition problems that might have been thought unsolvable.

For that reason, this section presents some examples of the application of advanced technology to acquisition management. Each system addresses some aspect of the requirements discussed in section 3. All employ technology that has already been developed and demonstrated; some employ technology that has already been commercially packaged.

It is important to note that components of each of these systems can be recombined to create a system satisfying all the needs identified by the Navy. These systems

are presented to show how advanced automation technology can be applied to solve specific requirements and should not be considered strawman proposals.

5.2 A Database Facility for Acquisition Management

Improvements in such functions as acquisition planning, impact analysis and change management rest ultimately on better management of information. Most of the information desired in these functions usually exist somewhere in the community - or in some readily tapped external source. The central problem is to make the needed information available to the right decision makers, at the right times, and in forms that are useful for their purposes. A key aspect of this problem is the management of the computer resident databases themselves.

Computerized databases are expensive and valuable resources which must be managed with as much care as inventories of valuable materials, stockpiles of exposives, or installations of expensive equipment. The key problems to be addressed in database management are:

1. data availability for both standard reports and unusual or unanticipated questions;
2. access control, so that each piece of information is available only to those authorized to use it;
3. data validation to insure that data is correct - at

entry when possible - and always before use;

4. data independence so that changes to details of one aspect of operations do not disrupt others (e.g., changes to database format should not affect users or running application software);
5. data consistency, so that the various elements of the database provide a logically consistent description of the objects, activities and organization they concern;
6. data integration, so that information from multiple sources can be combined effectively to provide a complete picture of factors which may relate to a decision.

Database management systems - functionally complete systems of software that provide integrated solutions addressing all of these needs - have been commercially available since about 1970. One part of a program to improve the information available to the acquisition community will be to employ recent database management technology.

There are three types of information which must be managed within the acquisition community; local operating data, selected shared management data and community information.

Local Operating Data

Local operating data is data collected by individual organizational units for use within those units. For

example, acquisition projects may collect data on the status of work in progress under their contracts. Good operating data at the unit level is the foundation of effective information management at all other levels. Good policy and effective strategic planning is possible only when basic operating data is sound.

However, there are two prime requirements for the development of good databases within operating units, such as the acquisition project:

1. The data must be gathered, stored and disseminated locally in forms - and according to standards - that are genuinely responsive to local needs; and,
2. The organization responsible for maintaining the data must control access to it and dissemination of it.

Only if these principles are followed will project managers feel that the data exists primarily to benefit their operation. Unless they feel that the data is for them, it will never be very accurate or timely. The military has many automated systems that have failed because they do not serve -- or honor the management prerogatives of -- unit commanders. These systems almost always fail primarily because the data stored in them is unreliable.

These principles are important in any organization, but they are especially important in the acquisition community. In this community:

a. Projects are highly autonomous, and project managers are strongly committed to preservation of their

management prerogatives; and,

b. There are significant variations in the detailed information needs of the various projects, due to differences in project age, acquisition philosophy, system to be delivered, technology and other factors; imposition of uniform database designs on all projects - in the case of operating data - would be a grave mistake.

Consequently, local operating data must be managed in databases flexibly structured to respond to the needs of the operating unit. These databases must be controlled by the operating unit and local access restrictions must be respected by the entire community.

Selectively Shared Data

The second important category of data, selectively shared data, flows between operating units for purposes of management reporting, coordination, joint planning, or cooperative action. Examples of this data are project status reports, financial reports, change notices, and schedules. In many cases the content of reports sent from one organization to another is drawn from local operating data. Some routine reports can be prepared automatically from local data. Others can be developed only from management interpretation and aggregation of local data.

The important requirement concerning selectively shared data is that access to it is still carefully con-

trolled. Thus some data may be available only to special task groups or inter-project working groups. Some data may be internal to NAVSEA - other data may flow between project managers to the Acquisition Review Board, but not be generally available. The point here is not to encourage secrecy, but to respect the ordinary practices of management. Information can generally be used most productively in an organization when it is complete, consistent, validated and evaluated. Systems that inadvertently lead to the dissemination of unevaluated data are often counter-productive.

Community Information

Community information is data gathered for the benefit of the entire community. It is stored in a database available to the entire acquisition community. Examples of community information are:

- macroeconomic planning factors
- industrial capacity data
- industrial product lead times
- labor union actions (e.g., strikes, potential strikes, and slowdowns)
- public information on shipbuilding or Navy policy
- regulations
- information reported to Congress
- Congressional directives.

Certain information originating as local operating data may eventually become community information. For example,

certain aspects of project histories may be valuable to all planners - and may be freely available to the entire community. (Other such data may be more closely held - the system must accommodate all choices).

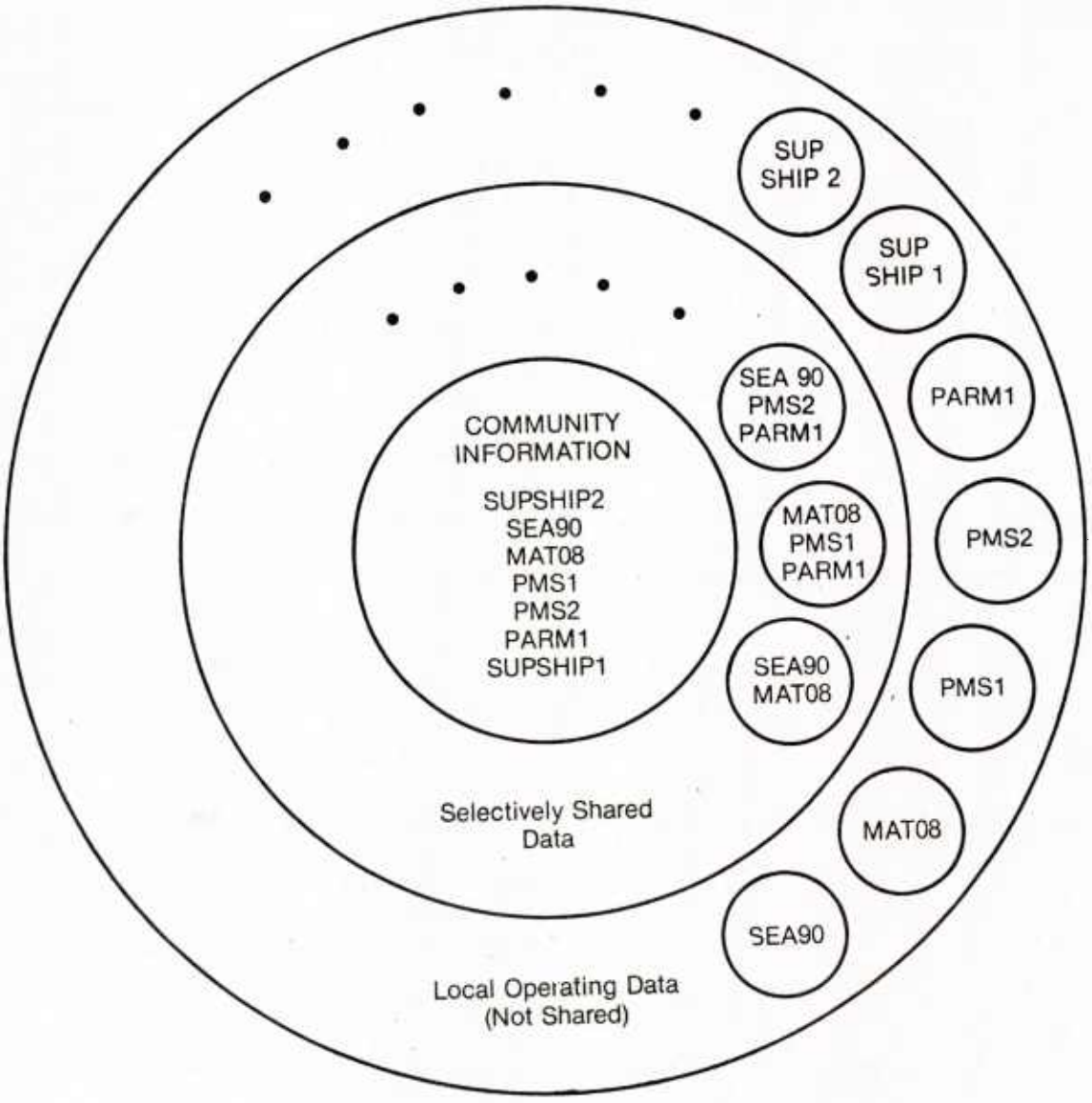
Figure 5.1 presents a conceptual view of the needed information structure. The outermost ring represents operating databases created by each group for use within that group. The diagram shows that there is no sharing of data among groups in the other ring. Thus only SEA90 may access the SEA90 database.

The inner circle represents a community database available to all groups.

The middle ring, representing selectively shared data - is made up of many databases, each available to certain groups. Thus, one database contains information that SEA90 and MAT08 share to coordinate their joint activities. Another contains data of joint interest to MAT08, PMS1 and PMS2. A third contains data to be accessed by SEA90, PMS2, and PARM1. Note that this selectively shared data is distinct from the local operating data in the outer ring. No doubt PMS1 would move data from its local database to the shared databases only after it was validated, consistent and ready for release.

Important characteristics of this architecture are:

a. data sharing is controlled, protecting autonomy of



Local Operating Data - Operating data of individual units—collected by unit for use strictly within unit.

Selectively Shared Data - Data reported by units for the use of other units—for coordination, planning, policy compliance—based on, but distinct from, local operating data.

Community Information - Data available to entire community—may be externally generated or extracted from selectively shared data.

SEA90, MAT08, PMS1, PMS2, PARM1, SUPSHIP1, SUPSHIP2 - are names of organizational units; each unit may access databases labelled with its name.

Figure 5.1 Conceptual Database Architecture

local operations; but

b. arbitrarily complex patterns of cooperation and data sharing are supported.

This appears to suit the needs of the acquisition community exactly.

5.2.1 Distributed Database Technology

Recent developments in database technology make the operation of distributed databases practical. A database is said to be distributed when:

a. it is broken up into pieces;
b. the pieces are dispersed to multiple, autonomously operating computers which may be geographically distributed; and,
c. the distribution is hidden from users and application programs.

Distributed database technology is of special interest in the acquisition community because of its geographically dispersed operations and requirements for both data sharing and project autonomy. One approach to applying the technology would involve the use of: (a) large shared computers for community data, and (b) minicomputers for local operating data. Then individual units would exercise exclusive operational control over computers housing their operating data. For widely shared data, economies of scale and the simplicity of centralized

operation would apply. Selectively shared data can be distributed over the minicomputers or stored centrally. The choice can be made on a case by case basis.

5.2.2 Application in the Acquisition Community

The distributed database described here has the potential to become the principal repository for all management information in the acquisition community. Both information of local interest to a single unit or project, and information to be shared among or exchanged by multiple units, becomes part of the database. Thus the database will contain project histories, estimated and actual costs, plans, schedules, and status information. The database will be the repository for such information as alternative plans under consideration and impact analyses, as well as such specific information as change notices.

It is vitally important to understand that all such data will typically enter the network as part of a local database -- as working data. In this status, it is stored on the local computer and is not available via the network to other groups. Thus, if a project has discovered that a key contractor is behind schedule -- and several alternative programmatic changes are under consideration -- the information concerning contractor status and alternative responses would typically be entered initially in the project's local database. At some point the project

management will be prepared to begin discussing alternative courses of action with shipyard supervisors, PARMs, upper management, etc. At that point, when it is appropriate to make status information and plans more widely available, the project manager can release relevant data to the network database. It is of central importance that:

a. all management data can be entered into the network of databases from its moment of origin; but,

b. control over the release and dissemination of the data is at all times in the hands of the owner of the data.

Thus creation of the data -- or entry of it into the database -- is wholly separate from dissemination or sharing of it.

Data in the database is accessed by data query systems, decision support systems, business procedure management systems and other tools described in later sections of this report. All such systems employ the database system to handle their data. Thus all systems are subject to the same data access control and exhibit the same independence of data location. All systems can be used in local operations on local data, and in joint operations on shared data. And all systems use the same, internally consistent collection of databases.

5.3 Decision Support for Acquisition Planning

5.3.1 System Description

This system will provide computer support for initial planning of acquisition projects, and for planning of major changes. Its philosophy is to support decision-making by demonstrating the effects of various alternatives. The system is not intended to derive automatically an optimal allocation of resources.

This system will allow the acquisition community to create and exercise a model that simulates the acquisition environment. All system displays will be graphic.

A model creation facility will allow users to formulate a graphically represented macro model of organizations that participate in the acquisition process. Tasks can be defined for each participating organization, and for each task,

a) prerequisite products produced by other tasks,

b) required resources,

c) task products, and

d) schedules

are defined. Resources are user-defined but normally include man-hours, facilities (such as dry docks) and money. Products can also be user-defined. The relation-

ship between a task's prerequisite products, the resources consumed and the products produced can be defined by a set of parameters that are also user-defined. These parameters (planning factors) should in fact be based on historical statistics gathered from previous acquisition projects (systematic project histories).

The activities that can be represented in this model are those that actually contribute to the production of ships. These include PMSs, PARMs, shipbuilders, and contractors. The system will allow a user to define an organization that creates products used by two others, consuming limited resources. This is shown in figure 5.2. This implicitly defines interrelationships such as those existing between two acquisition projects.

The system will support impact analysis through a top down analysis of resource and schedule requirements. The basic logic needed is similar to that used in Material Requirement Planning (MRP) systems. In MRP systems, a desired output schedule is specified; a "bill of materials" explosion together with the lead times for procuring prerequisite products and resources are used to determine the required schedule of available input. Here the "bill of materials" is a list of prerequisite products and resources, including labor and money. The system then uses the capacities of the participant organizations, defined in terms of facilities and resources available, to generate constraints on the inputs available for use.

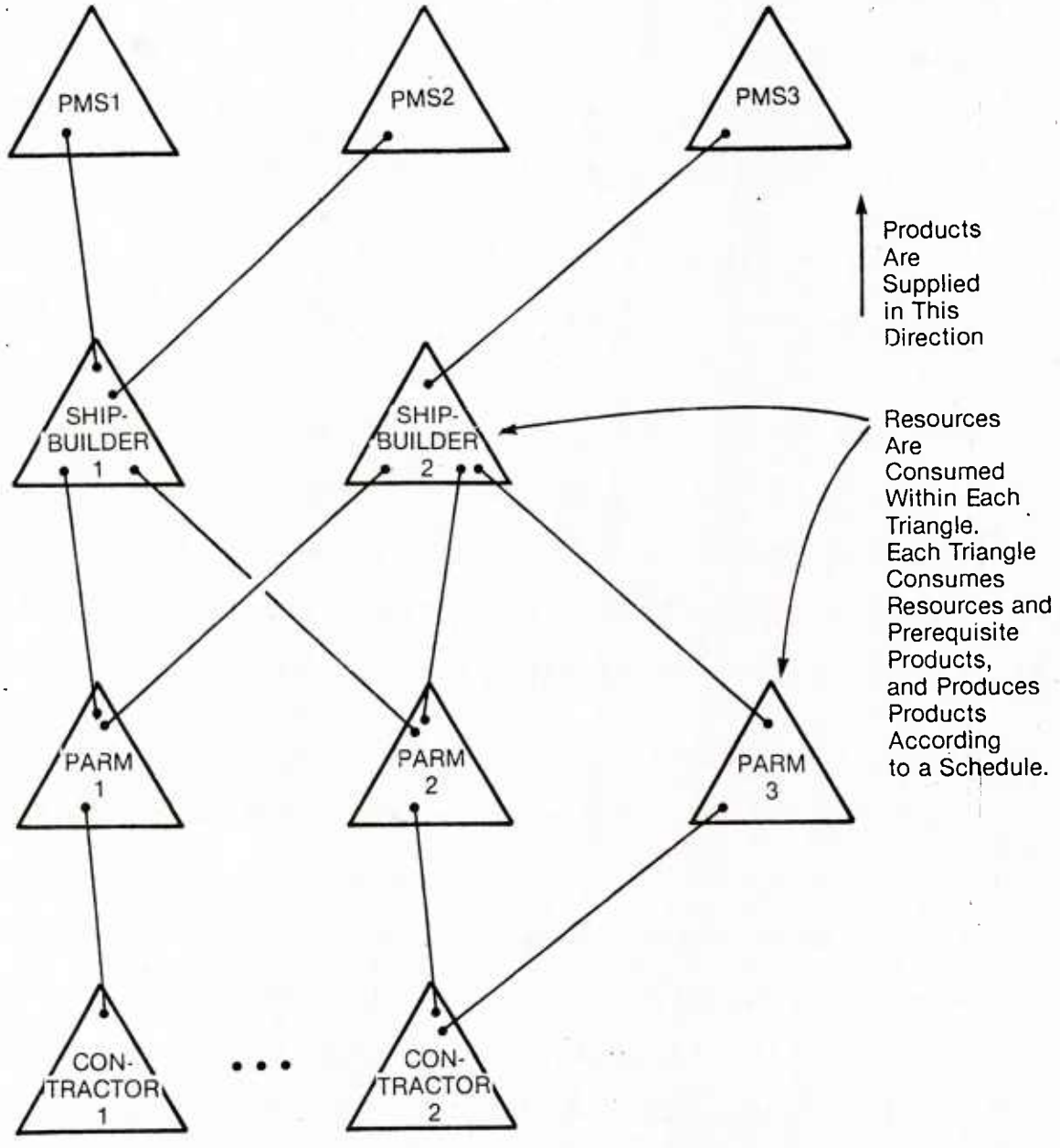

PMS1
PMS2
PMS3
Products Are Supplied in This Direction
SHIP-BUILDER 1
SHIP-BUILDER 2
Resources Are Consumed Within Each Triangle. Each Triangle Consumes Resources and Prerequisite Products, and Produces Products According to a Schedule.
PARM 1
PARM 2
PARM 3
CON-TRACTOR 1
CON-TRACTOR 2

Figure 5.2

These constraints are compared with the schedule of input availability required to produce the desired output. If any constraints are violated, alternative output schedules that satisfy the constraints can be generated. These alternatives demonstrate the impact that project changes have on the cost and schedule of all possible affected projects.

A critical aspect is that the system is not intended to derive an optimal production schedule. To do so would involve subjective tradeoffs between cost and value of different projects. Rather, the system will support decision-making by showing the effects of selecting various alternatives, and by demonstrating the costs (in terms of basic resources) of these choices.

A well-designed, user-oriented interface will make the system a working tool for planning. The interface must provide:

1. graphic display capability
2. storage of system inputs and assumptions (models)
3. storage of system outputs (results)
4. capability for easily changing model characteristics
5. appropriate summary capability
6. terminology and formats familiar to the user

These factors must all be usable with a minimum amount of training.

5.3.2 System Use

Specifying available resources does not uniquely determine production schedules and costs of Navy ships. Assignment of these resources to specific tasks is required. Therefore, the Acquisition Planning Decision Support System will be used to derive the various feasible alternative production schedules and the resources required to implement them, based on different allocations of resources (such as shipyard capacity). Identifying these alternatives will show where potential bottlenecks and trouble spots exist, and help identify trade-offs that can be made to improve overall results.

This system can be used by SEA90 or MAT08 to analyze interproject impacts. Such analysis will allow the Navy to optimize its programs Navywide without suboptimizing for a particular project. This would be done as follows: A model can describe the interrelationships among a number of existing projects, shipbuilders, PARMs and contractors, as shown earlier in figure 5.2. The interrelationship between projects through common shipbuilders would be evident, and the effect of one project on a particular shipbuilder can be translated into the effect on another project. These kinds of effects can be explored by exercising the model. The results of such simulations can be displayed graphically in real time using color where necessary. The product of each simulation can be stored along with the assumptions (such as specific acquisition

strategies) that were made. Thus, a number of choices in acquisition strategies can be simulated so that acquisition planners with PMSs, MAT08, and SEA90 can select the approach most beneficial to the Navy.

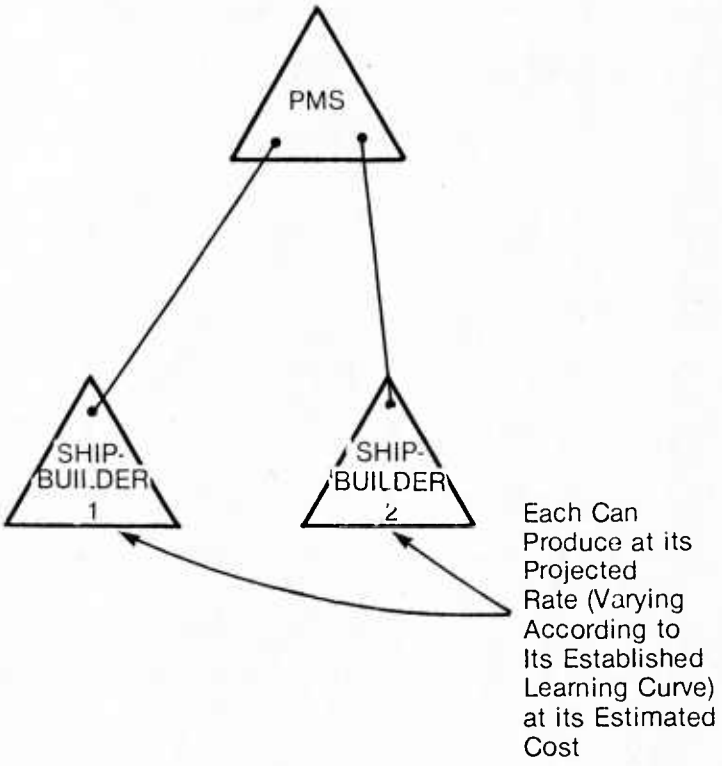
Project managers can also use the system to determine the optimal strategy within a particular project, subject to the constraints applied by higher authority. The system would be used to evaluate alternative strategies for constructing a ship class given a number of shipyards with limited capacity. This is shown in figure 5.3. The shipyard capability would be calculated from the total projected capability less all current or planned commitments to other projects. This system can also be used to determine the effect of a change in a PARM's plans on the costs and schedules of all projects supported by that PARM.

5.4 Communications and Filing

In several of the areas discussed in Section 3, the issue of communications among participants in the acquisition process is mentioned. Communications improvements -- beyond telephone and mail -- can be achieved with the support of several different kinds of systems (automated or electronic):

a. Message forwarding systems, on which messages can be

ALTERNATIVE 1



ALTERNATIVE 2

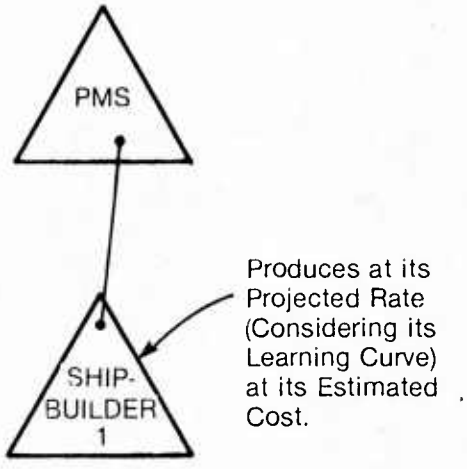


Figure 5.3

sent to active parties on a network

b. Electronic tele-conferencing with audio and video

c. Electronic mail.

Message forwarding systems are easy to use and can be simply designed. They often require sending and receiving parties to be on-line; variations store messages until the receiving party comes on-line. No electronic filing, composing, and retrieving capability generally exists within this class of systems, and these functions are performed manually before or after transmission.

Electronic teleconferencing offers the obvious advantage of visual contact without the need to travel. This tool would be effective for decision-making or fact finding conferences where parties can coordinate their schedules.

Electronic mail is an effective working tool if the parties must receive and send at their convenience. Such systems also support filing and retrieving of messages, so that communications are virtually self documenting. They also interface directly to databases for access to required information.

The system described below is a variation of electronic mail. Some examples of how it can be used in the acquisition environment follow.

The Navy already employs electronic message technology to support its worldwide operations. The current discussion is concerned with more pervasive use of this technology - employing somewhat different system designs - for maximum benefit to ship acquisition management.

5.4.1 System Description

A centralized system, with dial-up access by means of local terminals, will provide message composing, transmitting, and filing facilities.

The message composing facility allows users to create and edit messages consisting of three kinds of components:

- Header blocks contain sender, receiver, and title of message. There can be only one of these per message.
- Text blocks contain any text. There can be as many text components as needed per message.
- Tabular blocks contain tables of data. There can be as many tabular components as needed per message.

Standard text and tabular block form definitions can be created and stored. Use of these can standardize message formats and facilitate the composition process.

Block contents can be filled in from the terminal, can be extracted from blocks in other messages, or can be created from a database. Text blocks can be modified using text editing/word processing functions. Arithmetic

manipulation of tabular block contents is also possible.

Automated distribution of messages can supply an easy, quick means of sending messages to the intended recipients at their respective terminal sites. Messages can be addressed to individuals or to user defined distribution lists. Messages are forwarded on command and are available when their recipients are active on the system.

Messages are stored in user defined files for subsequent retrieval. Unsent messages can be kept in the files for documentation purposes or can be called up for subsequent revision. Received messages can be retrieved from the files for review. Users can also search files for messages that contain specific words or phrases.

A touch-sensitive graphic interface would allow filing and retrieval of messages by picking a file from a picture showing all user defined files. New file names would be entered from the keyboard. Touch sensitive graphics would also allow creation of header blocks from displays of previously defined distribution lists or individuals.

To prevent the disclosure of sensitive data and the unauthorized access to the forms and their contents, the system will provide internal security mechanisms which

include:

1. access rights verification by "credit card" device
2. cryptographic controls such as data encryption according to the 1977 National Bureau of Standards encryption algorithm; and
3. passwords for data files

Since data and forms manipulation and storage will occur locally, transmission of information to other organizations will take place only with the explicit intention and consent of the local user. Forms information can be released either by connection of the local system to a central computer for public use or by mail using cassettes and floppy disks to selected individuals. Existing procedures for handling and transporting classified documents can be employed when cassettes or floppy disks contain classified information.

5.4.2 System Use in Acquisition Context

This system will serve to satisfy the communication and documentation needs of the acquisition community in the following ways:

. Change Management - Proposed and approved changes can be communicated to affected parties using messages composed primarily of text, and some programmatic plan changes can be shown in tabular form. The messages can be sent to parties on standard distribution lists:

PARMs can notify all appropriate PMSs of changes; PMSs can notify PARMs and contractors of changes. By filing the messages, PARMs and PMSs can maintain a history of changes.

. Financial Management - Financial plans can be documented using tabular blocks in messages. Plans can be reported when necessary, and only at the appropriate level of summarization (using tabular summarizing functions). New plans can be documented by copying tabular data from old plans. For financial status reporting, PMSs, contractors, and report reviewers can use this facility. Financial status reports can show tabular data extracted from plans and contractor reports, with variances automatically calculated by tabular manipulation functions. Explanatory text can be extracted from various contractor reports, with additional material entered by the PMS. Reports can be distributed at the will of the PMS, and PMS and all recipients can file the report in their private project histories for their own use.

. Cost Estimating - Cost estimates can be prepared using tabular form capabilities, with text blocks documenting the assumptions made. Cost estimates can then be filed in the local project history file and retrieved based on date, assumption, and so forth. No distribution would occur, except possibly for desired external review.

5.5 Business Procedure System

Two needs mentioned by interview respondents were improved communication among acquisition participants and reduction in paperwork (both production and review). Much of the paperwork can be standardized, such as NSATS and SAR reporting. Some of these procedures -- again SAR and NSATS are examples -- require interoffice standardization and include interoffice communication. Other procedures, such as problem management within a PMS, can be standardized within one office, requiring only intra-office communication.

One way to support standard procedures and communications is with a business procedures system (office automation), some of which are commercially available. They allow definition of automated standard forms as well as automated standard procedures for completing, routing, and filing these forms. These automated procedures are tailored to the working procedures already in use. Office automation systems also provide electronic mail and filing capabilities for non-standard office action.

Since office automation systems are flexible, changes in standard procedure -- due to changed acquisition regulations or management -- can be accommodated. Improvements in management methods and needs for additional procedures can also be satisfied without completely replacing the system.

The description of such a system and examples of its use follow.

5.5.1 System Description

The system is composed of a dispersed series of conveniently located workstations, with graphic screens. Each can have local processing capability or can operate through a central processor of suitable size (see figure 5.4).

The business procedures office automation system supports an organization's standard procedures and forms. The system automatically routes and files electronically maintained and displayed forms to the workstations, each of which supports tasks performed by that organization's personnel.

The system is tailored to a specific office as follows.

1. Each office procedure is broken down into the sequence of its composite steps. Each of these steps may contain varying amounts of data entry and data review. The sequence of steps, which can be represented as a flowchart, may include decision points that are branches in the path based on the presence, absence, or value of some data (see top half of figure 5.5).
2. The standard forms for each procedure are defined.

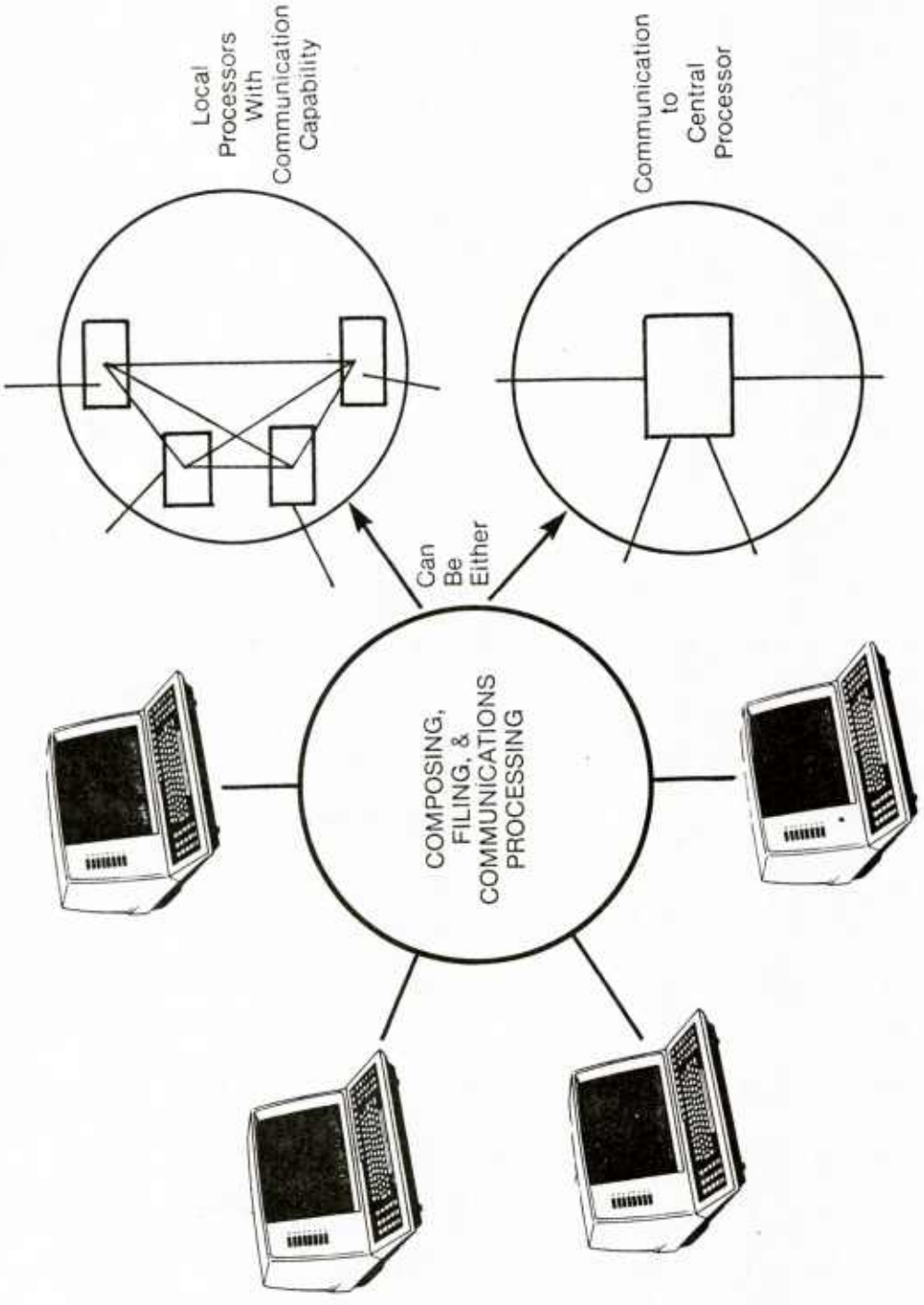

Local Processors With Communication Capability
Communication to Central Processor
Can Be Either
COMPOSING, FILING, & COMMUNICATIONS PROCESSING

Figure 5.4

The data within each form are identified and defined.

3. For each step (transaction), those sections of the forms that are filled in or reviewed are identified,

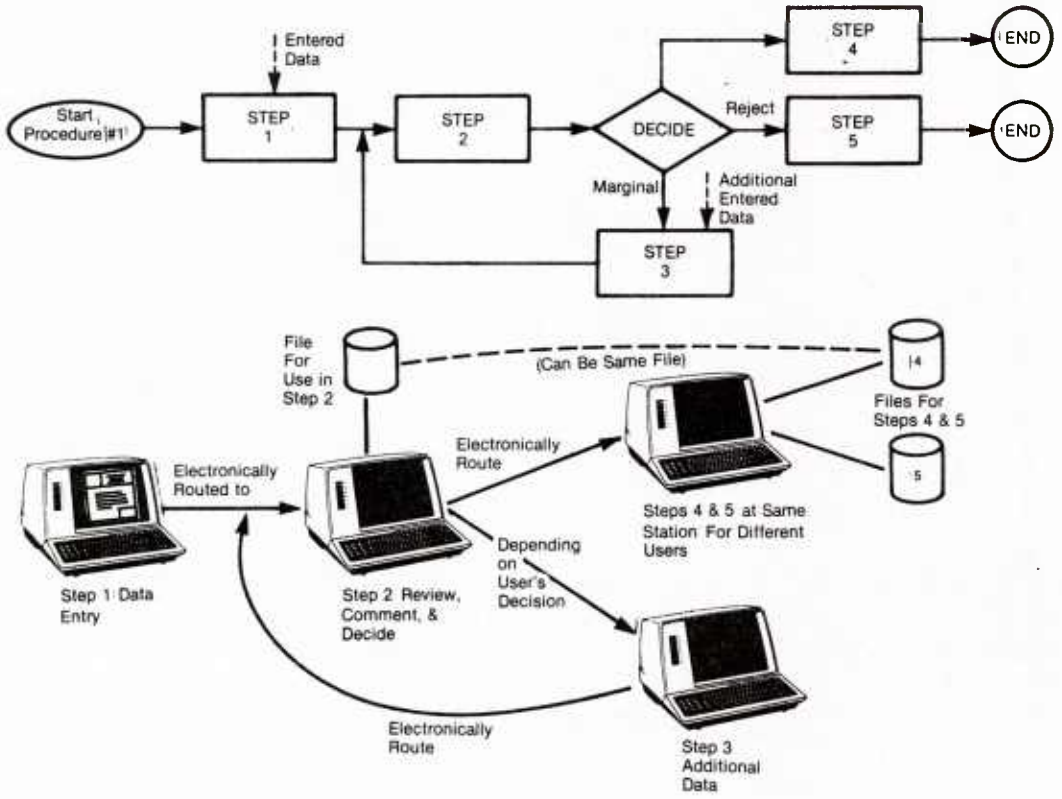


Figure 5.5

and the operations performed on those sections are defined. Possible operations include data entry, verification, viewing, copying (from other forms, possibly), editing, or manipulating (possibly by a mathematical or tabular operation). Decision opera-

tions are also identified, and the decision criteria are specified.

4. The transactions are assigned to work stations (see bottom half of page 5.5).

Thus, each workstation is used to complete at least one step in some office procedure. Workstations can, at different instances, support different steps, possibly within different procedures.

Besides standard procedures defined for a particular office, workstations may also have several "utility" functions. These allow users to perform various office related functions at their own convenience for their own purposes. They include:

- word processing
- electronic mail
- filing of electronic messages
- appointment calendars and travel plans

Special utilities may also be provided that allow verifying progress.

In operation, this business procedures system electronically maintains and routes all paperwork. Those who wish to initiate some action do so by completing the first step in the appropriate procedure; this may require (partial) completion of a form. Upon completion of that step, the form is automatically routed to the next station. When that station comes on-line, the forms waiting for action at that station become available. Completion of

the next step results in routing to subsequent stations. Completion of a procedure (as defined by the user of the system) may occur when final, approved documents are routed to one or more parties for their information or for action within their office. The recipient may then initiate one of his procedures.

5.5.2 System in Use in Acquisition Environment

This system potentially can support the "paperwork" and communication in such areas of acqusition management as engineering change management, program change management, financial reporting, and financial plan preparation and dissemination. An example for financial reporting follows:

Financial Reporting

A number of workstations are located at the PMSs, MAT08, SEA90, PARMs, shipbuilders, and contractors. The business procedures system is used to accummulate cost and schedule reporting data.

Contractors, shipbuilders, and PARMs, accumulate and report costs and milestone progress in the manner of (CS) . Reporting is as shown in figure 5.6.

Contractors and shipbuilders enter costs and milestone progress by means of the automated system, using

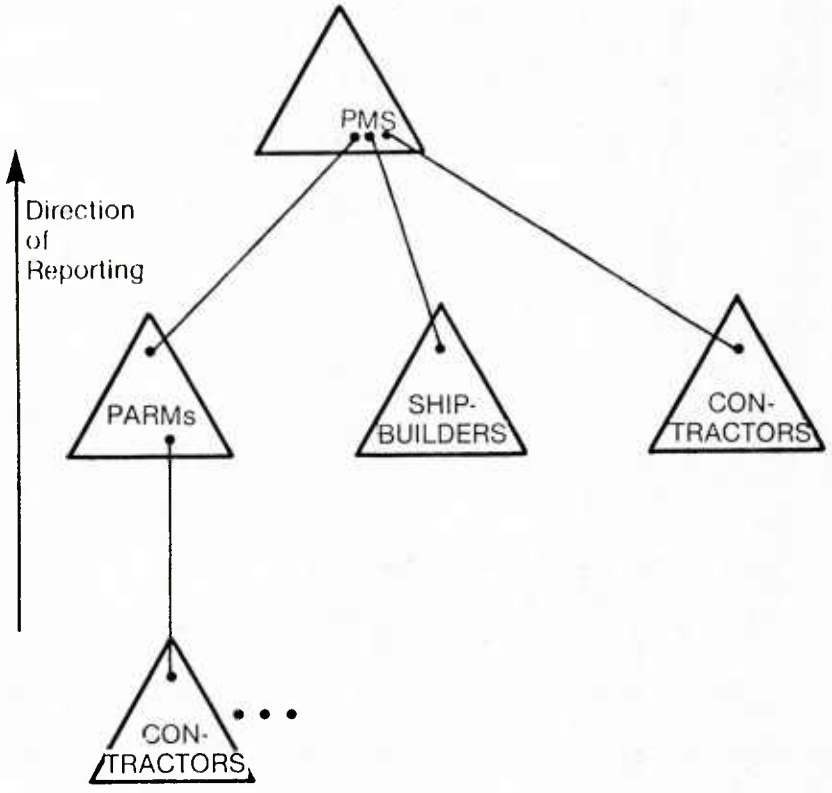


Figure 5.6

standard but flexible forms. PARMs assemble costs and milestone progress reports by project, using features that extract sections of contractor reports and recompose them for project reporting.

PMSs receive contractor, PARMs, and shipbuilder reports in standard form through the electronic mail feature. Several of the the clerical aspects of preparing NSATS and SAR reports are performed at one workstation in the PMS, as shown in figure 5.7. The result is a working draft that is private to the PMS. This is edited at

perhaps another workstation until the report is suitable for publication. The electronic mail feature is then used to forward the reports to MAT08 or SEA90.

At each step in the reporting procedure it is possible to insert the report into local private project histories. PMSs can maintain all contracts, shipbuilding, and PARM reports in a PMS local history file. This would be implemented as follows: The workstation transaction defined for reading contractor, shipbuilder, and PARM reports would automatically insert these reports into a file called "history". The transaction would also allow entry of key points in the report by which subsequent retrieval might be desired. MAT08 and SEA90 would also have workstation transactions defined for receiving NSATS and SAR reports. Initial reading would include the following steps.

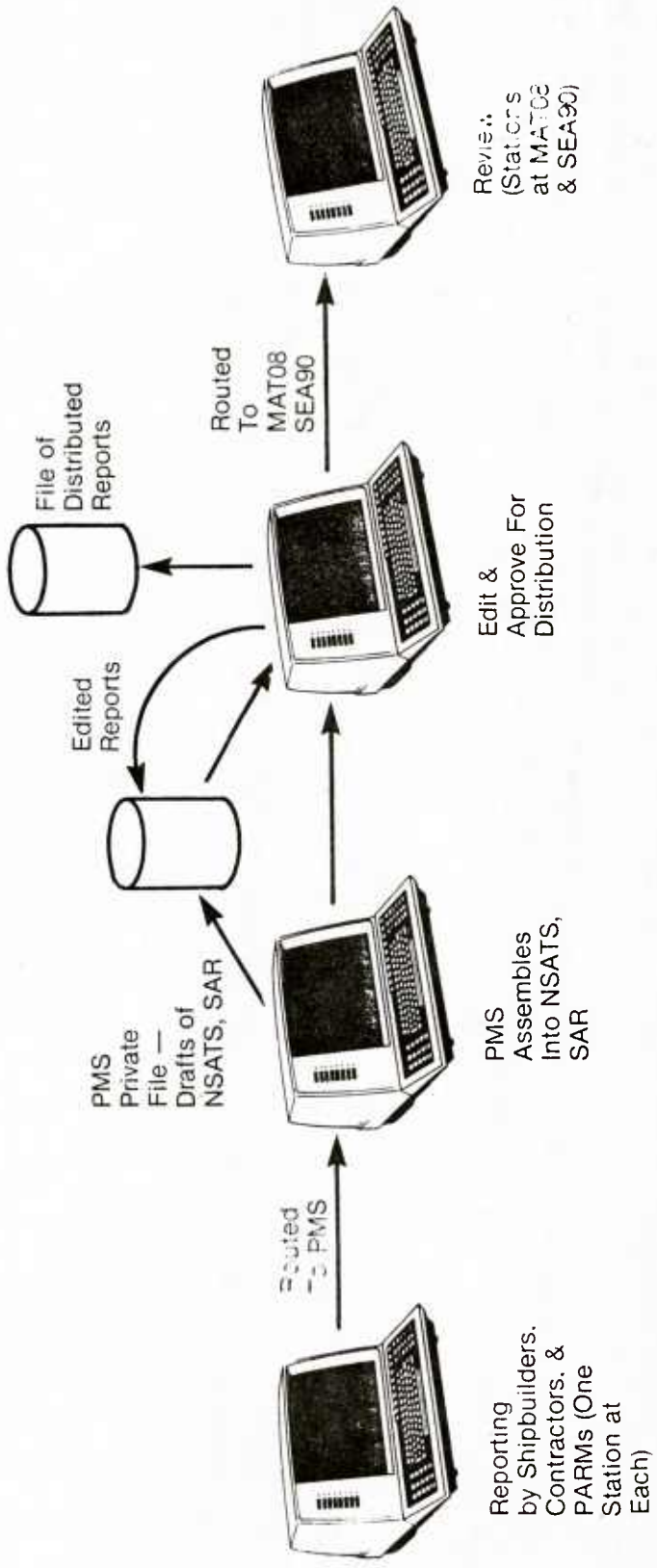

Reporting by Shipbuilders, Contractors, & PARMs (One Station at Each)
Routed To PMS
PMS Private File — Drafts of NSATS, SAR
PMS Assembles Into NSATS, SAR
Edited Reports
File of Distributed Reports
Edit & Approve For Distribution
Routed To MAT08 SEA90
Review (Stations at MAT08 & SEA90)

Figure 5.7

Machine	Acquisition User
1. display the report	read report
2. identify reported unsatisfactory or marginal areas	verify
3. identify routing within MAT08 or 9 for special review due to unsatisfactory areas	verify, add, or delete
4. request special characteristics for later retrieval	supply characteristics
5. save in MAT08 on SEA90 local project histories; route to appropriate parties within MAT08 in SEA90 for review	

Additional checking could also be incorporated in initial or subsequent readings. Options include:

- Automatic retrieval of the previous reports showing current and previous projections side by side.
- Automatic retrieval of previously defined plans to compose current and plan project progress. (This assumes that plans are reported to or entered at MAT08 or SEA90 using the system, and that these plans are in a form suitable for direct comparison to NSATS and SAR.)
- Automatic highlighting of areas to review based on "flags" set by reviewers of previous reports. (This assumes that on each review, reviewers specify those sections of the standard form report to review carefully on the subsequent report.)

5.6 Graphical Data Management and Display

Spatial Data Management is a technique for organizing and retrieving information by positioning it in a Graphical Data Space (GDS). This Graphical Data Space is viewed through a color raster scan display which enables users to traverse the GDS surface or zoom into the image to obtain greater detail. In contrast to conventional database management systems in which users access data by asking questions in a formal query language, a Spatial Data Management System (SDMS) presents the information graphically in a form which seems to encourage browsing and to require less prior knowledge of the contents and organization of the database.

Because of its flexibility in answering unstructured questions, this technique appears to be appropriate for the acquisition community.

5.6.1 System Description

Spatial Data Management is motivated by the needs of a growing community of people who need to access information in a database management system (DBMS) but who are not trained in the use of such systems. The information in an SDMS is expressed in graphical form and presented in a spatial framework, so that the information is more accessible and its structure is more obvious than in a

conventional DBMS. In this way, a user can find the information he seeks without having to specify it precisely or know exactly where in the DBMS it is stored.

The graphical data space is accessed through a set of three color, raster-scan displays. The left-most of the three screens presents a "world-view" map of the entire data surface. A magnified portion of this data surface is simultaneously displayed on the main screen in the center. The location on the data surface of this magnified portion is indicated by a highlighted rectangle which appears on the world-view map. The user can control which portion of the data surface appears on the main display by pressing on the joy stick shown in the foreground of the figure in the user's left hand. Pressing the joy stick in any given direction causes the user's magnified window to move in that direction over the data surface. This motion is reflected in the corresponding motion of the highlighted rectangle on the world-view map.

The data presented to the user on the main display can come from a variety of sources including any symbolic database management system.

A Spatial Data Management System offers several advantages over conventional, keyboard-oriented database management systems, including those offering natural language or "English-like" user interfaces. Six such

advantages are:

1. Motion through database is simple and natural.
2. The database is its own data dictionary.
3. The presentation of the data encourages browsing.
4. The placement of the data can convey information.
5. Graphics can be used to convey information.
6. The system can accommodate many unique data types such as photographs.

These are discussed below.

5.6.1.1 Motion Controls

The joy stick of SDMS provides a simple and natural means of moving through the database. By using one control, the joy stick, the user can explore the entire database. On the other hand, symbolic query languages require the use of a special syntax and semantics. Even in natural language systems, where the syntax is widely known and the semantics relatively intuitive, the user must learn the structure and contents of the database before he can find anything. In contrast, the data in an SDMS can be displayed in a manner which makes the contents and structure readily apparent, and does not require any prior knowledge of the structure of the database in order to retrieve information from it.

The level of abstraction at which the data is examined is similarly easy to control. Twisting a knob zooms

the picture and thus specifies the level of detail which is displayed, allowing the user to see global attributes such as the number of objects in a set without the burden of utilizing separate functions for aggregation. In addition, if the database administrator has set up more elaborate abstractions, these can be invoked by the user by the same simple mechanism, requiring no additional knowledge on his part.

When dealing with very large databases this control of detail makes it possible for the user to see the entire database on the world-view display, even if there are more elements in the database than can occupy discrete positions on the television screen. The database administrator need merely define an abstraction which groups the data elements together in some suitable manner. For example, a database of ships might be grouped according to hull type. The more abstract views of the graphical data space would then display the groups instead of the individual elements, allowing the user to see the entire database and move quickly to the location of some particular area of interest. Once he had centered that area on the screen, twisting the knob would cause the individual elements to appear.

5.6.1.2 The Graphical Data Space as its own Data Dictionary

A conventional DBMS requires the use of a data dictionary to inform the user of the structure of the database. Even natural language user interfaces suffer from the problem of educating the user as to what queries may be answered from the information contained in the database. In contrast, the graphical data space of SDMS is its own data description. Rather than specify a relation and attribute name, the user merely traverses the data surface until he reaches the desired information, at which point the data is laid out in front of him.

5.6.1.3 Browsing

The user of an SDMS is almost always presented with a display which gives him more information than he immediately needs. Within this presentation, finding the required information is facilitated by the distinctive visual qualities which can be imparted to the data. At the same time, the "unsolicited" surrounding data makes it possible for the user to browse through the database. This is a difficult activity in a conventional database system where every piece of data must be requested explicitly. While a small database may be printed out and examined, the lack of any mechanism for placing related data together would make such a technique impractical for

very large databases. Likewise, it would be very tedious to submit repeated queries and such a technique would be ineffective if the user was not already familiar with the contents and structure of the database.

In contrast, SDMS allows the database administrator to arrange the information in the database according to any chosen attributes. Once the user has positioned his window in the vicinity of the data being sought, he can browse through the surrounding area, letting the appearance of the icons (the user defined graphic representation of the data) determine where he focuses his attention.

5.6.1.4 Using Icon Position to Convey Information

The placement of a particular icon can be used to aid in recalling a particular datum, in much the same way that a person finds some needed information in his office by recalling where he put the piece of paper on which it was written.

The placement of an icon may also convey information directly. For instance, the location of each ship can indicate its nationality and type. A personnel database could be arranged according to seniority or salary. Each of these organizations could be displayed in a separate part of the graphical data space, allowing the user to select which arrangement suited his specific query. He

could then observe the world-view map to get an overall picture, such as seeing how many items were in each category, and he could move his magnified window over some particular area to look at exceptional, extreme, or average values.

5.6.1.5 Graphic Representations

Graphic representations are often the most vivid means of conveying information, especially for aiding in the perception of trends in large aggregations of data. The most familiar form of this technique is the histogram or the graph, where numeric data is displayed in graphical form. The graphical output facilities of SDMS make such display of numeric data possible as a natural extension of the system.

Graphical representations may also be used to advantage in displaying trends in non-numeric data. For example, a database of ships could be displayed against the background of a map, with the wake behind each ship indicating its speed and direction. With each display, it would be easy to spot trends that would be hard to formulate into symbolic queries, such as a large number of ships heading for the Middle East.

5.6.1.6 New Data Types

An SDMS is not restricted to data that originates as numbers and character strings. The raster scan output devices and digital storage of graphical data provide a natural means of storing images such as photographs. An optical videodisk can be controlled through SDMS to provide for storing a very large number of video images.

5.6.1.7 Interface to a DBMS

An SDMS is not restricted to a specific DBMS. The graphics mechanism is superimposed on top of the database management system and therefore requires no modification to the user's original symbolic data, allowing SDMS to be used to access an existing (possibly shared) database. Since the display mechanism is external to the database, it is possible to define multiple graphical views of the same data.

5.6.2 Use in the Acquisition Community

Like the database management system described in section 5.2, the graphic interface provided by an SDMS can be a general purpose tool. The acquisition community can be provided with one standard user interface for

- accessing information in a database (such as financial data, budgets, histories),
- invoking functions that use data (such as impact analysis tools),
- storing information, and
- accessing communications channels.

This standard interface would provide the acquisition community with a standard framework on which to add additional capabilities according to need.

APPENDIX A

Letter from Admiral A.J. Whittle, Jr., regarding project

DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON, D C 20360

IN REPLY REFER TO
Ser 00/54
22 January 1980

From: Chief of Naval Material

Subj: Acquisition Management Information System; development of

Encl: (1) Points of Contact

1. The Naval Material Command has recently initiated a task to develop an Acquisition Management Information System. The system will probably consist of numerous modules which support the various organizations involved in acquisition with the initial emphasis on ships and systems installed aboard ship. Accordingly, the modules will have many users at various levels of the NMC.

2. The Office of Naval Research/Naval Material Command (ONR/NAVMAT) Acquisition Research Council has contracted with two companies, ROH and Computer Corporation of America for the system architecture. The development procedure will require that the personnel of these companies visit the offices of your activity to conduct interviews, research instructions, investigate organizational and reporting relationships and examine information flows and decision making processes. The results will be analyzed and a specification for system development prepared.

3. It is recognized that some key personnel time may be required during interviews and the possible follow-up discussions. Therefore, the interviews will be requested, via written correspondence, sufficiently in advance to minimize disruption. Points of contact in NAVMAT and ONR and the two companies are listed in enclosure (1).

4. The cooperation of your activity is requested. The success of this project, in part, depends on the assistance received and the accuracy of the information provided.

A. J. WHITTLE, JR.

Distribution:
COMNAVAIRSYSCOM
COMNAVELEXSYSCOM
COMNAVFACENGRSYSCOM
COMNAVSEASYSCOM
COMNAVSUPSYSCOM

POINTS OF CONTACT

L. P. Timmeney
NAVMAT (MAT 08D21)
692-3127/8

E. Prentiss
NAVSEA (SEA 90)
692-2750

M. Denicoff
ONR (ONR-437)
692-4303

R. L. Callahan
ROH, Incorporated
2001 S. Jefferson Davis Highway
Suite 1105
Arlington, VA 22202
(703) 920-7806

R. Winter
Computer Corporation of America
575 Technology Square
Cambridge, MA 02139
(617) 491-3670

ENCLOSURE (1)

APPENDIX B

List of Documents in Document Library

INSTRUCTION/ DIRECTIVE	TITLE	DATE
OMB Circular No. A-109	Major System Acquisitions	5 Apr 76
OFPP Pamphlet #1	Discussion of Application of OMB, Cir A-109	Aug 76
DDR&E	Navy Agreement Concerning Implementation of DOD Dir 5000.1 for Ship Programs	11 Aug 75
DOD Dir 4105.68	Procurement Research	22 Jan 77
DOD Dir 4120.3	Defense Standardization Program	23 Apr 65
DOD Inst 4140.41	Government-Owned Material Assets Utilized as Government Furnished Material for Major Acquisition Programs	26 Jul 74
DOD Dir 5000.1	Major System Acquisitions	19 May 80
DOD Dir 5000.2	Major System Acquisition Process	19 Mar 80
DOD Dir 5000.3	Test and Evaluation	19 Jan 73
DOD Dir 5000.19	Policies for the Management and Control of Information Requirements	12 Mar 76
DOD Inst 5000.22	Guide to Estimating Costs of Information Requirements	17 Oct 74
DOD Dir 5000.28	Design to Cost	23 May 75
DOD Dir 5000.30	Defense Acquisition Executive	20 Aug 76
DOD Dir 5000.34	Defense Production Management	31 Oct 77
DOD Dir 5000.35	Defense Acquisition Regulatory System	8 Mar 78
DOD Dir 5010.19	Configuration Management	17 Jul 68
DOD Dir 5030.8	Office of the Coordinator for Ship Repair and Conversion for the Department of Defense and the Department of Commerce	24 Sep 76
DOD Dir 5030.9	Coordination of Shipbuilding, Conversion and Repair for the Department of Defense	19 Jan 72
DOD Dir 5100.62	Clearance of Research and Studies with Foreign Affairs Implications	19 Aug 69
DOD Inst 7000.2	Performance Measurement for Selected Acquisitions	10 Jun 77

INSTRUCTION/ DIRECTIVE	TITLE	DATE
DOD Inst 7000.3	Selected Acquisition Reports (SAR)	23 Sep 75
DOD Inst 7000.10	Contract Cost Performance, Funds Status and Cost/Schedule Status Reports	6 Aug 74
DOD Inst 7000.11	Contractor Cost Data Reporting (CCDR)	5 Sep 73
DOD Inst 7045.7A	Planning, Programming and Budgeting System	29 Oct 69
DOD Dir 7200.4	Full Funding of DOD Procurement Programs	30 Oct 69

INSTRUCTION/ DIRECTIVE	TITLE	DATE
SECNAVINST 3900.37A	Rapid Development Capability for Warefare Systems	27 Oct 71
SECNAVINST 4000.29A	Development of Integrated Logistics for Systems/Equipments	13 Jan 71
SECNAVINST 4700.6	Coordination of Shipbuilding, Conversion, and Repair for the Department of Defense	22 May 72
SECNAVINST 5000.1A	System Acquisition in the Department of the Navy	17 Nov 78
SECNAVINST 5000.16D	Policy, Roles, and Responsibilities within Department of Navy for Implementation of the DOD Planning, Programming and Budgeting System (PPBS)	8 Jan 70
SECNAVINST 5000.25A	Procedures for Updating Program Data in the Five Year Defense Program (FYDP)	30 Jan 70
SECNAVINST 5200.30	Management Decision Coordinating Papers (DCP) and Program Memoranda (PM) within the Department of the Navy (DN)	27 Aug 75
SECNAVINST 5200.32	Management of Embedded Computer Resources in Department of the Navy Systems	11 Jun 79
SECNAVINST 5250.2A	Management Studies and Analyses Performed By, or For, the Department of the Navy, Approval of Requests to Contract For	19 Apr 79
SECNAVINST 5260.1C	Information Requirements Control	20 Oct 76
SECNAVINST 5420.172B	Establishment of Department of the Navy Systems Acquisition Review Council (DNSARC)	18 May 76
SECNAVINST 7000.14B	Economic Analysis and Program Evaluation for Navy Resource Management	18 Jun 75
SECNAVINST 7000.15B	Contract Cost Performance, Funds Status and Cost/Schedule Status Reports	5 Dec 74
SECNAVINST 7000.17A	Performance Measurement for Selected Acquisitions	25 Apr 72
SECNAVINST 7000.18B	Policy for the Development of Financial Management Systems in the Department of the Navy	12 Apr 77
SECNAVINST 7000.19B	Department Cost Analysis Program	12 Mar 75

INSTRUCTION/ DIRECTIVE	TITLE	DATE
SECNAVINST 7000.20	Contractor Cost Data Reporting (CCDR)	10 Apr 74
SECNAVINST 7043.2A	Full Funding of DOD Procurement Programs	12 Dec 69
SECNAVINST 7700.5C	Selected Acquisition Reports (SAR)	16 Apr 76
SECNAVINST 7810.12	Progress Payments Based on Percentage of Completion for Shipbuilding	17 Jul 75

INSTRUCTION	TITLE	DATE
CNO LTR Ser 97D1/159	Joint Navy/MARAD Design Team	19 Apr 73
OP90 MEMO	Staffing Requirements for Major (DCP) Acquisition Programs	4 Jan 77
OPNAVINST 3811.1A	Threat Support to Weapon System Selection and Planning	30 Aug 78
OPNAVINST 3900.22A	Rapid Development Capability for Warfare Systems	31 May 74
OPNAVINST 3960.10	Test and Evaluation	22 Oct 75
OPNAVINST 4100.3A	Department of the Navy Integrated Logistics Support (ILS) System	6 Nov 72
OPNAVINST 4700.8F	Trials, Acceptance, Commissioning, Fitting Out, Shakedown and Post Shakedown Availability of U.S. Naval Ships Undergoing Construction/ Conversion/Modernization	24 Jun 72
OPNAVINST 4720.9D	Approval of Systems and Equipment for Service Use	23 Aug 74
OPNAVINST 5000.37A	Management and Conduct of Studies and Analyses	20 Apr 79
OPNAVINST 5000.41B	Pre-Defense Systems Acquisition Review Council (DSARC) Procedures	30 Mar 74
OPNAVINST 5000.42A	Weapon Systems Selection and Planning	3 Mar 76
OPNAVINST 5000.46	Decision Coordinating Papers (DCPs), Program Memoranda (PMs) and Navy Decision Coordinating Papers (NDCPs) Preparation and Processing of,	10 Mar 76
OPNAVINST 5420.53A	General Precept for the Conduct of Trials and Material Inspections of Ships and Service Craft	30 Mar 70
OPNAVINST 5420.70	Mission, Organization, and Functions of the Board of Inspection and Survey	2 Apr 71
OPNAVINST 7000.17A	Cost Analysis	15 Sep 76
OPNAVINST 7000.18	Economic Analysis and Program Evaluation for Navy Resource Management	27 Jul 73
OPNAVINST 7043.2B	Reporting Requirements under Title 10, USC Section 139 (Congressional Data Sheets)	16 Jul 76
OPNAVINST 7710.18	Ship Cost Adjustment Report	19 Jun 73
OPNAVINST 9010.300	Top Level Requirements and Top Level Specifications for the Development of Naval Ships	4 Jan 74

INSTRUCTION/ NOTICE	TITLE	DATE
NAVMATINST 3900.13	Preproduction Reliability Design Review	13 Nov 75
NAVMATINST 3900.15	Certification and Registration for Access to DOD Scientific and Technical Information (located DDC/NTIS File)	5 May 77
NAVMATINST 3910.7B	Planning Procedures for the Department of the Navy Development Program	3 Oct 74
NAVMATINST 4000.2B	Integrated Logistic Support Planning Policy	27 Jun 75
NAVMATINST 4000.29	Basic Principles of Logistics	1 Mar 68
NAVMATINST 4000.34	Logistics Support Requirements System	15 Jun 71
NAVMATINST 4000.38A	Standard Integrated Support Management System	27 May 77
NAVMATINST 4130.1A	Configuration Management	1 Jun 74
NAVMATINST 4330.37	Should Cost	25 Mar 74
NAVMATINST 4330.38	Pricing and Overhead Monitoring	10 Sep 74
NAVMATINST 4341.1	GFM for Major Acquisition Programs	27 Jun 75
NAVMATINST 5000.18A	HQ Naval Material Command Participation Relative to DSARC	12 Mar 74
NAVMATINST 5000.19B	Weapon Systems Acquisition Program Review	24 Jun 74
NAVMATINST 5000.19C (Prop)	Appraisal Within NMC	
NAVMATINST 5000.22	Weapon System Selection and Planning	14 Jan 75
NAVMATINST 5000.23	Defense Systems Acquisition Review Council (DSARC)	20 Mar 75
NAVMATINST 5000.26	Onsite Project Manager Representative	17 Feb 76
NAVMATINST 5000.27	Evaluation of the Systems Acquisition Process	2 Mar 76
NAVMATINST 5040.2A	Project Management Reviews	11 Feb 72
NAVMATNOTE 5200	NAVMAT Selected Acquisition Tracking System (NSATS)	22 Jan 79
NAVMATINST 5200.11B	Project Master Plan	22 Jul 74
NAVMATINST 5200.14B	Management Information and Data Systems	17 Nov 71

INSTRUCTION/ NOTICE	TITLE	DATE
NAVMATINST 5400.14	Ship Life Cycle Management, Objectives and Policies for	7 Apr 69
NAVMATINST 5430.60	HQ Naval Material Command (HQNAVMAT) Organization Manual	10 Jul 78
NAVMATINST 7000.14B	Management within NMC for Ship Development Acquisition/Conversion Projects	30 Jul 71
NAVMATINST 7000.17C	Contractor Cost Performance Measurement	30 Jan 74
NAVMATINST 7000.19A	Cost Analysis Program	30 Jul 76
NAVMATINST 7000.20	Contractor Cost Performance and Funds	15 Jun 73
NAVMATINST 7000.23	Contractor Cost Data Reporting	9 Dec 74

NAVMAT PUBLICATION	TITLE	DATE
P-5240	C/SCSC Joint Implementation Guide	1 Oct 76
P-5241	Contractor Cost Data Reporting (CCDR) System	5 Nov 73
P-5242	Joint Design-To-Cost Guide	3 Oct 73
P-5243	C/SCSC Joint Surveillance Guide	1 Jul 74

INSTRUCTION	TITLE	DATE
NAVSEAINST 1543.1	Manpower, Personnel, and Training Support for NAVSEA - Cognizant Ship, System, Equipment, and Non-Hardware Developments	19 Aug 75
NAVSEAINST 3900.2A	Reliability and Maintainability Program of the Naval Sea Systems Command for Design, Development and Acquisition (Non-Nuclear)	18 Apr 79
NAVSEAINST 3900.6	Assignment of NAVSEA Research and Development Work to Shore Activities	27 Jul 77
NAVSEAINST 3960.1	Total Ship Test Program for Ship Production (TSTP/SP), Implementation of	9 Sep 76
NAVSEAINST 3960.2A	Test and Evaluation	2 Nov 78
NAVSEAINST 4105.1	Integrated Logistics Support (ILS), Policy, Responsibilities, and Planning	22 Jul 77
NAVSEAINST 4120.3	Defense Standardization Program (DSP) Within the Naval Sea Systems Command	10 May 77
NAVSEAINST 4121.1	Ship Specifications, Preparation, Review, and Revision of	9 Apr 77
NAVSEAINST 4130.1	Record of Chances (ROC)/Shipbuilding and Conversion Navy (SCN),	16 Oct 74
NAVSEAINST 4130.10	Configuration Control Board Operations for Systems and Equipments, Establishment of	20 Sep 78
NAVSEAINST 4200.1A	NAVSEA Contractor Procurement Review Program	1 May 78
NAVSEAINST 4200.8A	NAVSEA Contractor Support Services and Sole Source Contracts, Review, Management, and Control of	7 Mar 79
NAVSEAINST 4205.1	Approval for Procurement of Development by Fixed Price Type Contracts	1 Oct 74
NAVSEAINST 4340.1	Government Furnished Information (GFI) Management System	14 Jan 76
NAVSEAINST 4341.2	Policy on Government Furnished Material for New Construction and Conversion Projects	25 Feb 77
NAVSEAINST 4355.4	Quality Evaluation Test Sample Provisions, Policy for	18 Mar 77
NAVSEAINST 4370.1A	Contract Terminations, Administration of	21 Sep 77
NAVSEAINST 4441.1	Fleet Logistic Support Improvement Program (FLSIP) Coordinated Shipboard Allowance Lists (COSAL) for Construction, Major Conversion, and Overhaul	11 Sep 76

INSTRUCTION	TITLE	DATE
NAVSEAINST 4441.8	Allowance Lists for Boats and Landing Craft, Policies, and Procedures Governing	
NAVSEAINST 4441.12A	Supply Support of the Operating Forces	9 Aug 73
NAVSEAINST 4720.1A	Approval for Service Use for Systems and Equipment	17 Feb 78
NAVSEAINST 4720.3	Fleet Modernization Program, Policies, Procedures, and Responsibilities	7 Nov 75
NAVSEAINST 4720.11	Shipboard Installations and Modifications Performed Outside the Formal FMP Process, Centralized Control of	15 May 79
NAVSEAINST 4800.1	Manufacturing Technology Program	30 May 78
NAVSEAINST 4855.24	NAVSEA Acquisition Product Quality Program Evaluations	13 Dec 77
NAVSEAINST 5000.1	Navy Department Studies, Coordination of	28 Jul 75
NAVSEAINST 5000.2	Onsite Project Manager Representative (PMR)	24 May 76
NAVSEAINST 5100.12	System Safety Program for Ships, Shipborne Systems and Subsystems, and Equipment, Requirements for Implementation of	16 May 78
NAVSEAINST 5200	NAVMAT Selected Acquisition Tracking System (NSATS)	(Proposed)
NAVSEAINST 5200.2A	Reporting Requirements to the Naval Material Command Center	7 Jun 76
NAVSEAINST 5200.4	Project Master Plans	7 Nov 75
NAVSEAINST 5220.4A	Tasking/Funding NAVSEC, Washington, D.C.	21 Sep 78
NAVSEAINST 5230.6A	Procedures and Requirements for MIS and Data Systems (Cross Reference NAVSEA ADP Info Book)	12 Apr 78
NAVSEANOTE 5400	Principle Deputy Commander for Acquisition (SEA90), Assignment of Additional Responsibilities	8 Apr 79
NAVSEANOTE 5400	Reorganization of NAVSEASYSCOM	9 Apr 79
NAVSEAINST 5400.1A	NAVSEASYSCOM Headquarters Organization Manual	18 Jul 77
NAVSEAINST 5400.12	Surface Weapon System Test and Evaluation Responsibility, Assignment of	20 Mar 75

INSTRUCTION	TITLE	DATE
NAVSEAINST 5400.17A	Charter for the Combatant Craft, Service Craft and Emphibian Acquisition Project (PMS 300)	15 Aug 77
NAVSEAINST 5400.27	Procedures Governing the Transfer of Management Responsibility for Ships Between SHAPM's and SLM's	6 Apr 76
NAVSEAINST 5400.43	Program Managers in Design Division, Criteria for Establishment of	2 Mar 77
NAVSEAINST 5420.18B	NAVSEA Executive Board	16 Jul 79
NAVSEAINST 6240.1A	Environmental Quality Program	20 Dec 77
NAVSEAINST 7000.3	Ship Project Directive System, Implementation of	30 Jul 75
NAVSEAINST 7000.4A	Cost/Schedule Control System Implementation and Surveillance	7 Dec 77
NAVSEAINST 7100.4	General Guidance for the Budget and Apportionment Submission in Support of NAVSEA Programs	13 Apr 76
NAVSEAINST 7110.1	Training Support Funding Responsibilities in NAVSEASYSCOM	4 Feb 75
NAVSEAINST 7300.1A	Navy-Wide Standard Document Number and Accounting Classification Reference Number (ACRN)	8 Dec 77
NAVSEAINST 7300.10	Classification of Cost Estimates	24 Aug 78
NAVSEAINST 7300.13	NAVSEA Cost Estimating and Analysis Program for GFM	23 Jan 80
NAVSEAINST 7301.6	Administrative and Operating Procedures for Program Review System (PRS)	1 Apr 75
NAVSEAINST 7301.22	Shipbuilding and Conversion, Navy Appropriation Procedures for Financial Managements of	15 Dec 77
NAVSEAINST 7700.1	Selected Acquisition Report	11 Jun 76
NAVSEAINST 9060.1	Top Level Specifications (TLS) for New Ship Design	6 May 75
NAVSEAINST 9060.2	Design to Cost Guide for Ship Acquisition	24 Jul 75
NAVSEAINST 9060.3	Ship Acquisition Plan Outline and Ship Acquisition Plan	24 Nov 75
NAVSEAINST 9060.4	Ship Acquisition Process	29 Mar 76

INSTRUCTION	TITLE	DATE
NAVSEAINST 9060.5	Ship Acquisition and Logistic Support, Combat System Design Requirements and Combat System Operational Design	29 Mar 76
NAVSEAINST 9070.3	Ship Models, Procurement of	15 Aug 75
NAVSEAINST 9091.1	Procedures and Responsibilities for Certification of Aviation Facilities in Naval Ships Operating Aircraft	15 Sep 78
NAVSEAINST 9098.1	Models and Mock-ups of Shipboard Spaces and Systems (Except for Nuclear Propulsion Plan Spaces); Procedures and Inspecting Requirements for	24 Apr 78
NAVSEAINST 9221.1	U.S. Navy Main Propulsion Steam Generating Plan Inspection and Certification Program (Nuclear Excluded); Responsibilities for	21 Dec 77
NAVSEAINST 9593.1	Sewage Systems on U.S. Navy Surface Vessels, Certification Program for	15 Nov 78

Naval Sea Systems Command Report on Funding in Support of the Automatic Data Processing Equipment (ADPE) Modernization Program	25 Jun 79
Naval Sea Systems Command Automated Management Information Systems	2 Mar 79
Naval Sea Systems Command ADP MIS Plan (Identification of Users Objectives and Functional Requirements)	
Naval Sea Systems Command Handbook of Procedures and Requirements for Management Information and Data Systems (NAVSEAINST 5230.6A)	
Selected Acquisition Reports (SAR) System Functional Description	22 May 79
Naval Sea Systems Command Master Acquisition Control Register	Jun 79
Specification for the Development of a NAVSEA Data Base Dr. F. Frisch	6 Oct 78

Acquisition Management - Presentations that describe briefly:

- o Financial Reporting and Information Requirements
- o Cost Performance Reporting and Baseline Management
- o Cost/Schedule Status Report (C/SSR)
- o Cost/Schedule Control Systems Criteria

Progress Report to the Congress 1976 on Cost Accounting Standards Board

Naval Sea Systems Command Monthly Progress Report for Shipbuilding and Conversion — 1 Aug 79

The Naval Material Command Manpower Requirements Model by MANTECH, INC. — Jun 78

Information for Navy Witnesses Appearing before Congressional Committees — Jan 78

MIL-STD-1679 Weapon System Software Development — 1 Dec 78

REPORTS, STUDIES, AND ARTICLES

"Government Procurement Policy: A Survey of Strategies and Techniques"
B. R. Lenk — 21 Mar 77

"Annual Report on the Status of the Shipbuilding and Ship Repair Industry of the United States 1976" — Apr 77

"Management Update: Navy Major System Acquisitions"
Don Sowie Associates, Inc. — Sep 77

"A General Technique for R&D Cost Forecasting"
W. J. Weida — Sep 77

"Ship Acquisition Research"
M. Denicoff — 1976

"The Naval Ship Acquisition Process as a System"
S.M. Dean, C.R. Jones, and M.G. Sovereign — Feb 78

"Report of the Acquisition Cycle Task Force"
Defense Science Board 1977 Summer Study — 15 Mar 78

"A Preliminary Review of the United States Shipbuilding Industry and its Ability to Support the United States Navy"
J. D. Morgan — May 78

"The Profitability of the U.S. Shipbuilding Industry 1947-1976"
E. M. Kaitz — 20 Jun 78

"Escalation Clauses in Shipbuilding Contracts"
J. D. Vellis, II — Jun 78

"Investigation of Implementation of DODI 7000.2, Contractor Reporting Criteria"
Log/An, Inc. — Undated

"Conceptual Analysis for the Development of an Acquisition Information System"
International Applied Science and Technology Associates, Inc. — Mar 79

"Recommendations of Naval Shipbuilding Committee, Shipbuilding Council of America, Pertaining to Long Range Naval Shipbuilding"
Shipbuilders Council of America — 5 Mar 79

"Costing Methods and Models for Acquisition Planning, Budgeting, and Contracting"
Office of Federal Procurement Policy, Fed Acquisition Institute — Apr 79

"Introducing a Formal Strategic Planning System in a Business Firm"
A. C. Hax and G. Schulmeyer — Jun 79

"Final Report for Research on Mergers, Conglomerates, and Diversification"
A. C. Hax — Dec 79

Ninth Annual DOD/FA Acquisition Research Symposium Proceedings

"Some Acquisition Strategy Implications Drawn from a Theoretical Examination of the Front End of the Process"
A. Stuart Atkinson

"Affordability - Not a Dirty Word"
RADM L. S. Kollmorgen, USN

"The DOD Affordability Policy"
Truxton R. Baldwin

"Improving the Acquisition System"
Dr. Robert J. Massey, Gordon A. Smith, and Jack F. Witten

"Estimation and Analysis of Navy Shipbuilding Program Disruption Costs"
CAPT Colin Hammon, USN; Dr. David R. Graham

"Contract Negotiations Via Closed-Circuit Television"
Joseph C. Groth

"Second Sourcing in Major System Acquisitions"
LCDR D. S. Parry, SD, USN; LCDR B. R. Sellers, SC, USN

"Use of Fixed Price Incentive/Award Fee Contracts for the Construction of Follow U.S. Navy Ships"
Dr. Arthur C. Meiners, Jr.

"Enhancement of Competition in the Department of Defense"
Daniel D. Unruh

Reports Received from DDC

"Computer System Emulation Technology Assessment for AN/UYK-5 Replacement Program"
Naval Ocean Systems Center, San Diego, CA 1 Feb 79

"Formal Design and Analysis of Distributed Data Processing Systems"
Dr. Donald R. Fitzwater Jul 79

"System Level Concurrency Control for Distributed Data Base Systems"
D. J. Rosenkrantz, R. E. Stearns, P. M. Lewis Nov 77

"A High-Speed Parallel Data Link Between Co. Resident Mini Computers"
E. C. Demone Jun 79

"Military Program Management: A Guide to Wonderland"
H. L. McKinley, Air War College Apr 78

"Analysis of the Guided Missile Frigate (FFG-7 Class) Ship Acquisition Project"
J. D. Brotherton, NPS Monterey Mar 79

Lead Ship Analysis on FFG-7, DD-963, AO-177 & CGN-38 for GFE, GFI, Production Working Drawings and Labor Progress

NAVSEA Position Papers on Naval Ship Procurement Process Study

- o Industrial Input to Budget
- o Class C Budget Submittals
- o Supporting Industry Base
- o Progress Payments
- o Validated Drawing Effectiveness
- o Stable Shipbuilding Program
- o Workload Window

Naval Ship Procurement Process Study Final Report Jul 78

United States General Accounting Office Report LCD-79-113
Duplication in the Navy's Management Information Systems

TRANSIM - A General Purpose Problem Solving Tool
D. L. McMicheal, B.S. Orleans
Naval Engineers Journal Oct 73

Risk Management Keeps Aircraft Carrier Overhaul Planning on Schedule
G. F. Jurges
Naval Engineers Journal Oct 73

Production and Construction - A Comparison of Concepts in Shipbuilding and Other Industries
Dr. F. Frisch Jul 76

FY 80 NAVSEA Tiger Team Information

Systems Acquisition - A Plan for Research & Development
ONR/NAVMAT

System Acquisition Schedule Milestones (SESCO)
Guidance for SHAPM's

FFG-7 Class Validated Drawing Program
The Concept, Worth, and Applicability to Future Programs

Need for a Macroeconomic Approach to Supplement the Current Navy Resource Allocation Process
CDR Rolf Clark

Navy Initiated Changes Planned or Underway to Copy with Shipbuilder Delay and Disruption

EXISTING SYSTEM DESCRIPTIONS

Descriptions of Existing or Developing Management Systems in Support of Specific Ship Acquisition Projects

Information Management Procedures
for Processing Contractor Submittals
for Additional Consideration
(LHA-Class Claims Documentation)

PMS-383 Management Information System
Description SD01

PMS-400 AEGIS Management Information System

Major Surface Combatant Ship Project (PM 18)

Management Information Baselines

MANUALS, HANDBOOKS, MILSTD

Ship Life Cycle Management Manual, 0900-054-9010	Oct 69
Top Level Specification Handbook	Apr 75
Fitting-Out Management Information System, General Requirements	
MIL-STD 1626 (Ships)	Jun 74

APPENDIX C

How to Read an SADT Model

C. How to Read an SADT Model

This section describes how to read an SADT model. Only those features of SADT used in this document are described.

C.1 SADT Is for Understanding Systems Via Modeling

SADT is a technique that enables people to understand complex systems, and enables them to communicate their understanding to others.

As used here, a "system" may be defined as any combination of machinery (hardware), data and people, working together to perform a useful function. SADT may be applied in planning, analysis, design, project management, or whenever a documented understanding of a complex subject is useful. The result of applying SADT is a "model" that shows, in a series of diagrams the understanding gained.

In order to completely describe a given system, several models may be needed, each expressing a particular viewpoint. In analyzing a system, it is often easier to study and describe a system from several viewpoints (to be reconciled) than to force one viewpoint on the analysis. In this project, for example, four models were developed:

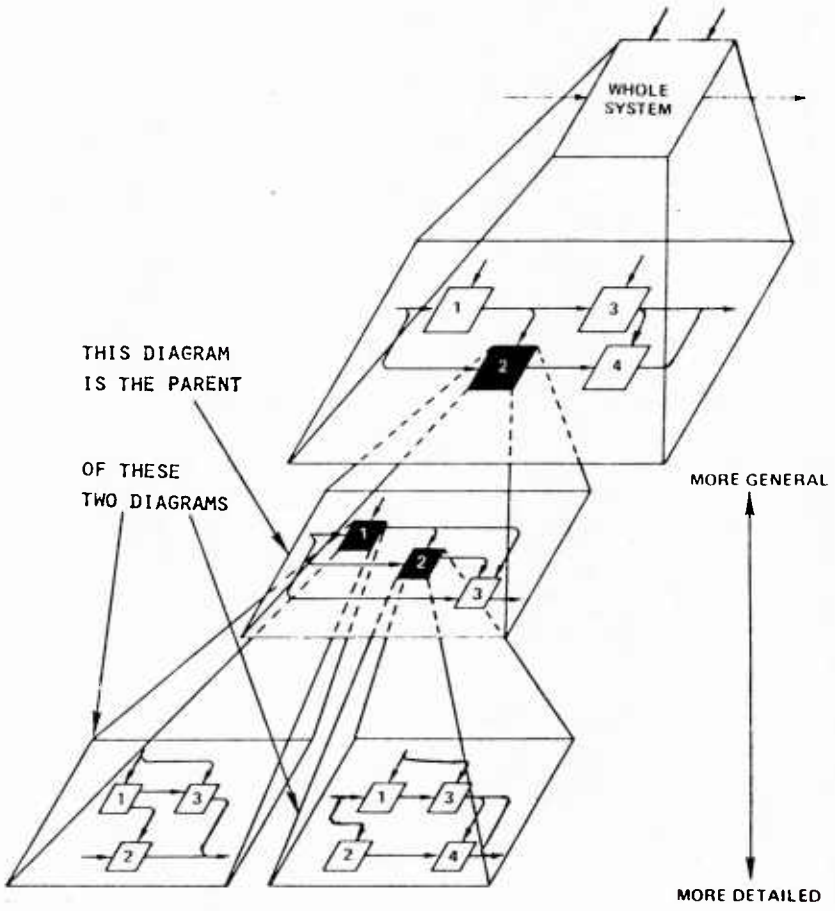
Model Name	Content	Viewpoint
PROJ	Describes project activities	Ship Acquisition Mgr.
PMS	Describes project management	Acquisition Mgr.
MAT08	Describes assessment of projects	MAT08
SEA90	Describes advising acquisition management	SEA90

Each of these models is identified by its Model Name. These are used in node numbers and reference numbers, to be described shortly.

C.2 "Top-Down" Organization of the Model

The diagrams in a model are organized in a hierarchic and modular "top-down" fashion, showing the breakdown of the system into its component parts. Application of SADT starts with the most general or abstract description of the system to be produced. If this description is contained in a single "module", represented by a box, that box is broken down into a number of more detailed boxes, each of which represents a component part. The component parts are then detailed, each on another diagram. Each part shown on a detail diagram is again broken down, and so forth, until the system is described to any desired level of detail. Lower level diagrams, then,

are detailed breakdowns of higher level diagrams. At each stage of breaking down the system, the higher level diagram is said to be the "parent" or overview of the lower-level "detail" diagrams.



C.3 Diagrams are Indexed by Node Numbers

In an SADT diagram, the component parts are shown as numbered boxes. A diagram may have no more than six boxes.

Each box is detailed in one diagram at the next lower level until a sufficient level of detail is reached.

The place of each diagram in a model is indicated by a "node number", derived from the numbering of boxes. For example, A21 is the diagram which details box 1 on the A2 diagram. Similarly, A2 details box 2 on the A0 diagram, which is the top diagram of the model. This hierarchy may be shown in an index of diagram names and their node numbers called a "node index". The node index serves as a table of contents for a model.

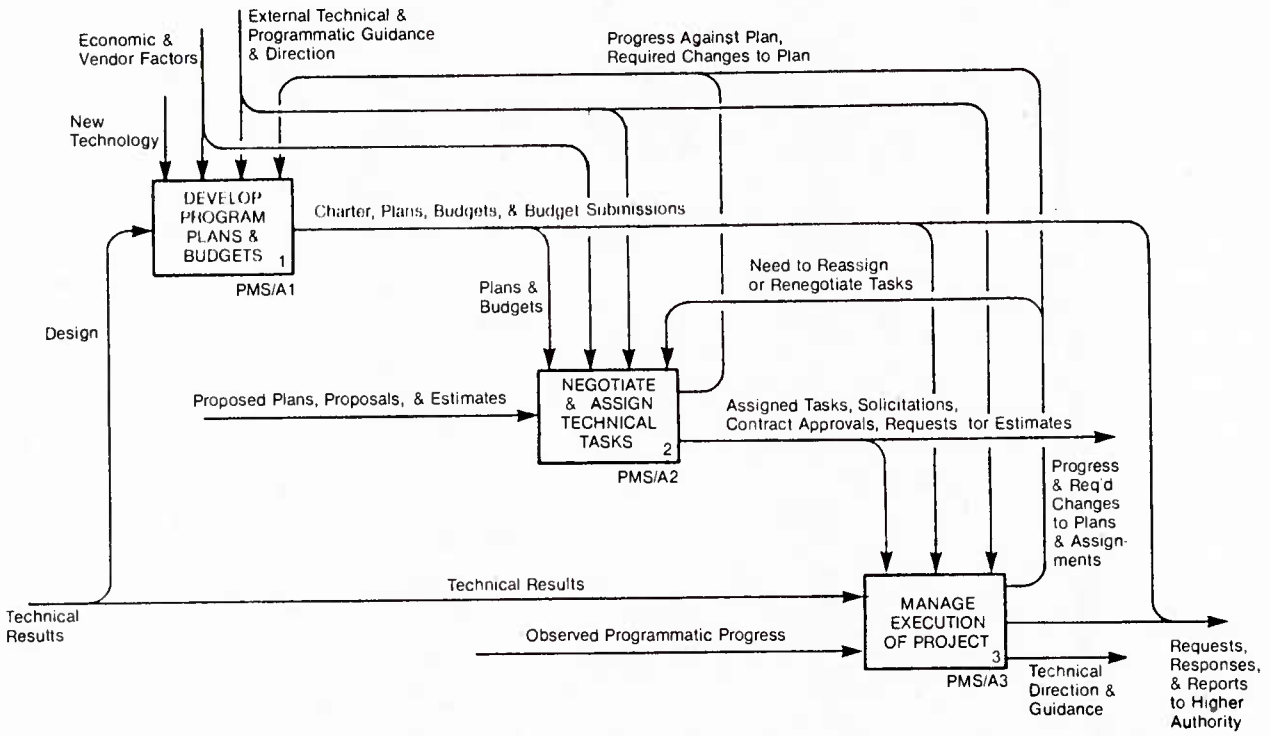
When multiple models are used, as is the case here, the node number includes the model name, as in PMS/A1.

C.4 Diagrams Consist of Labeled Boxes and Arrows

In SADT, boxes represent components in the breakdown, and arrows represent relationships between these components. Descriptive labels are written inside each box and along each arrow to describe their meaning. The notation is kept simple to permit easy reading with little special training.

The following is a sample SADT diagram. Notice that the boxes represent the breakdown of activities or functions performed

by the system and are named by verbs. Arrows, which represent objects or information, are labeled with nouns. As a variation of standard practice, boxes here will have a reference number below them to correlate their use: (1) in a diagram; (2) in the discussion (in earlier sections); and (3) on their detailing diagram (node number). This reference number is the same as the node number of the diagram that decomposes that box (whether or not that diagram has been produced yet).

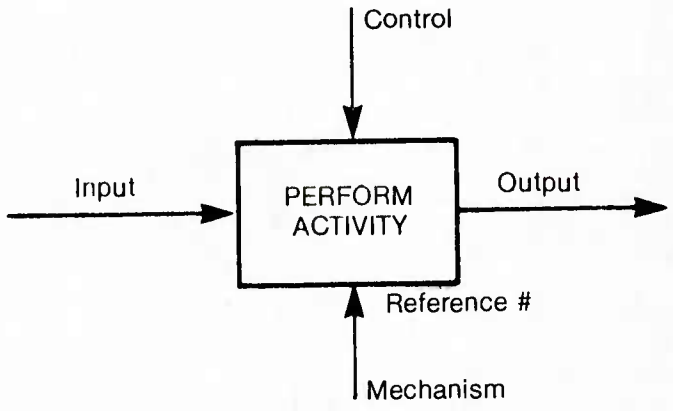


NODE: PMS/A0 TITLE: Manage Acquisition Project

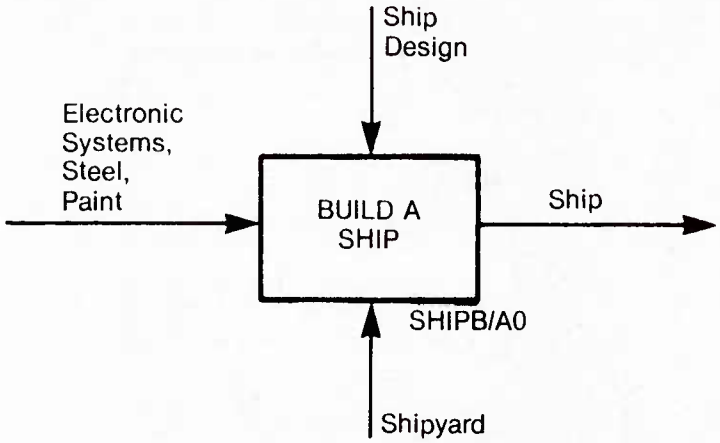
C.5 Box and Arrow Syntax

The sample SADT diagram shows that the descriptive names and labels convey the box and arrow contents to the reader.

In addition to its label, the side at which an arrow enters or leaves a box shows its role as an input, control, output, or mechanism for the box.



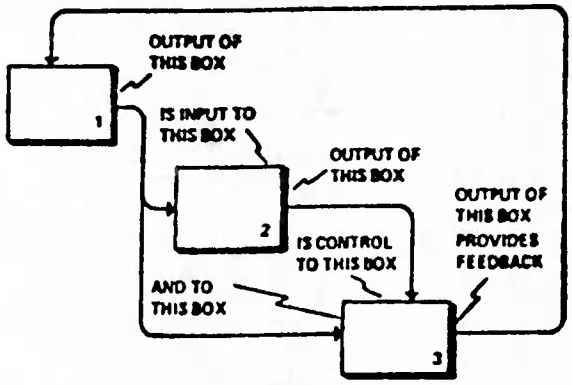
Inputs (on the left) are transformed into outputs (on the right). Controls (on the top) govern the way the transformation is done. Mechanisms (on the bottom) indicate the means by which the function is performed. A "mechanism" might be a person or a committee or a machine or a process.



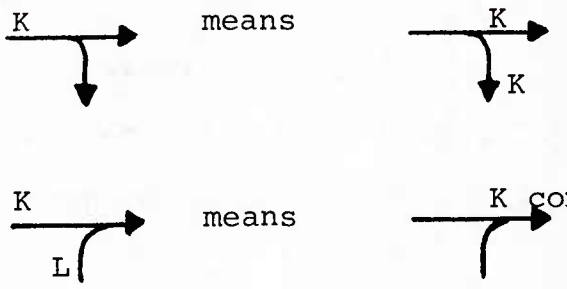
Arrows represent single things or general classes of objects or information. The arrow label describes what the arrow represents.

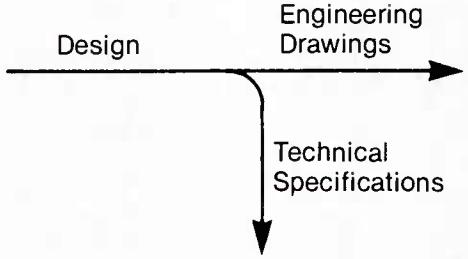
The arrow structure of an SADT diagram represents a constraint relationship among the boxes. It does not represent flow of control or sequence. The arrows entering a box show all that is needed by the box to perform its function. Therefore, the box is constrained by its input and control arrows.

An output of one box may satisfy some or all of the input or control conditions required by one or more other boxes. It is not necessary that each and every box have input and control and output. Also, several boxes can be performing their functions simultaneously.



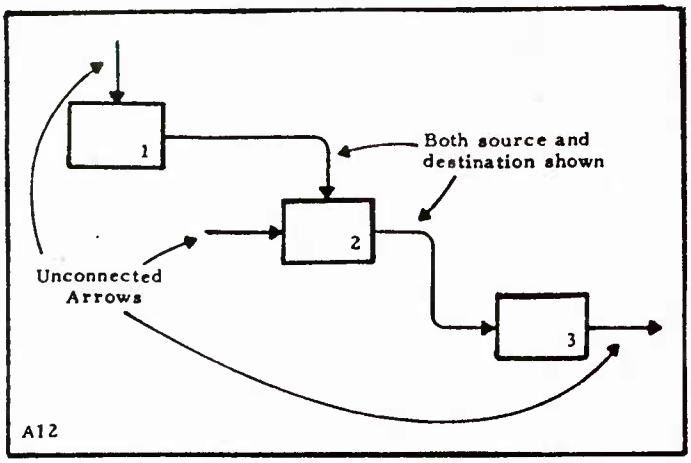
Arrows may branch or be joined. The branches may each represent the same thing, or different things of the same general type.





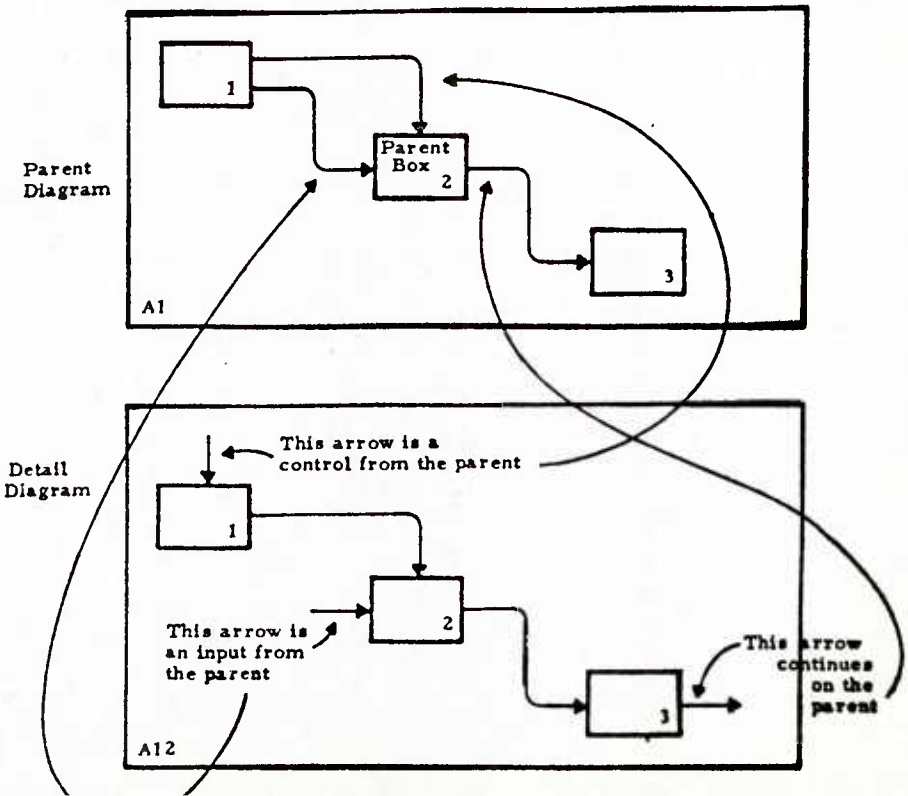
C.6 Arrows Show the Connection between Parent and Detail Diagram

Some arrows show both their source and destination boxes on the same diagram, while other arrows have one end unconnected. The unconnected arrows represent inputs, controls, or outputs of the parent box. To find the source or destination of these unconnected arrows, the reader must locate the matching arrows on the parent diagram. All such unconnected arrows must continue



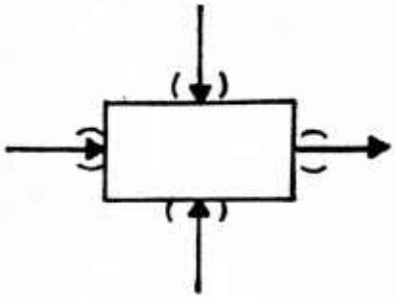
"UNCONNECTED" ARROWS ARE DERIVED FROM THE "PARENT"

THE MATCH MUST BE COMPLETED AND CONSISTENT

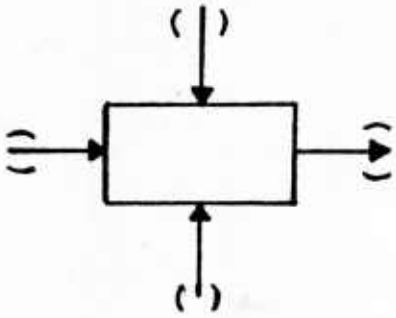


on the parent for the diagrams to be complete and consistent.

In very special cases, an unconnected arrow on a detail diagram has no matching arrow on its parent, or vice versa. In this case, the arrow head or tail is shown enclosed in parentheses.



No match shown on detail diagram for these arrows



No match shown on parent diagram for these arrows

An example of using this notation is shown on Diagram PMS/A-0, for the fourth control arrow "Acquisition Policy". In this case, acquisition policy is clearly needed, but showing its detailed use is not important to understanding lower level diagrams.

C.7 How to Explore a Model

SADT models may be used as a reference, providing all details of a particular subject, or as a tutorial, providing an overview of the whole system. To read the model for its

overview, use the node index to find all high-level diagrams. Disregard detail diagrams. For example, an overview is obtained as described above by studying A-0, A0, A1, A2, and A3.

To read the model for reference, use the index to find all diagrams detailing the subject of interest. Disregard unrelated diagrams.

C.8 Diagram Binding Order

When published, the diagrams in a model are bound in "node number" order. That is, all detail diagrams relating to one box on an overview diagram are presented before the next overview diagram and its detail. This order places related diagrams together and follows the order of the node index table-of-contents.

C.9 Systematic Diagram Reading Steps

The precise information about a system is in the diagrams themselves. The following reading sequence is recommended:

1. Scan only the boxes of the current diagram to gain a first impression of the decomposition.

2. Using the parent sketch as a guide, rethink the message of the parent. Note how the arrows feeding to and from the appropriate box reappear in the current diagram.

3. Then, consider the internal arrows of the current diagram to see how it works in detail. Consider the boxes from upper left to lower right. Examine the arrows by going clockwise around each box. Check the story being told by the diagram, by considering how familiar situations are handled.

This sequence becomes quite natural and ensures that the major features of each diagram receive attention. The reader should find that, with a little concentration, the diagrams are not difficult to read.

APPENDIX D

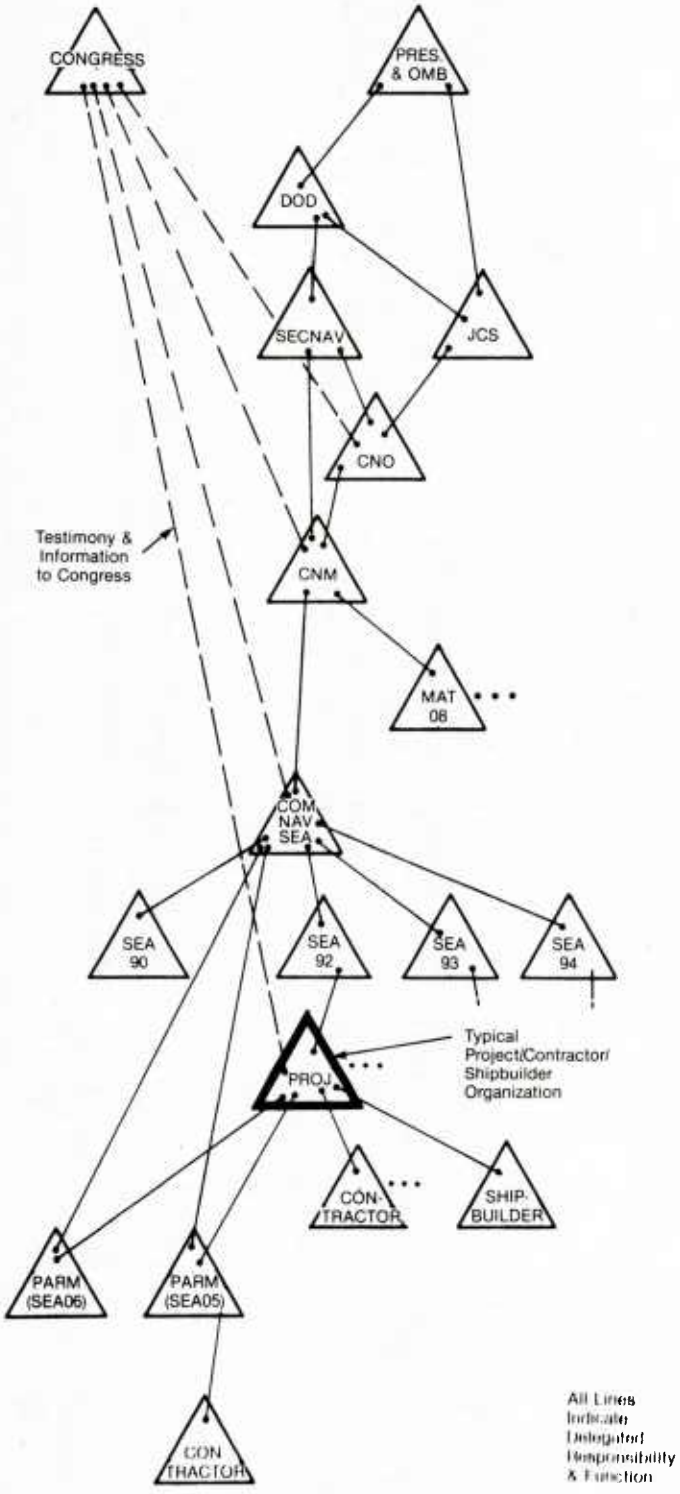
Framework: Summary Models of PMs, MAT08, and SEA90 Acquisition Functions and Associated Information

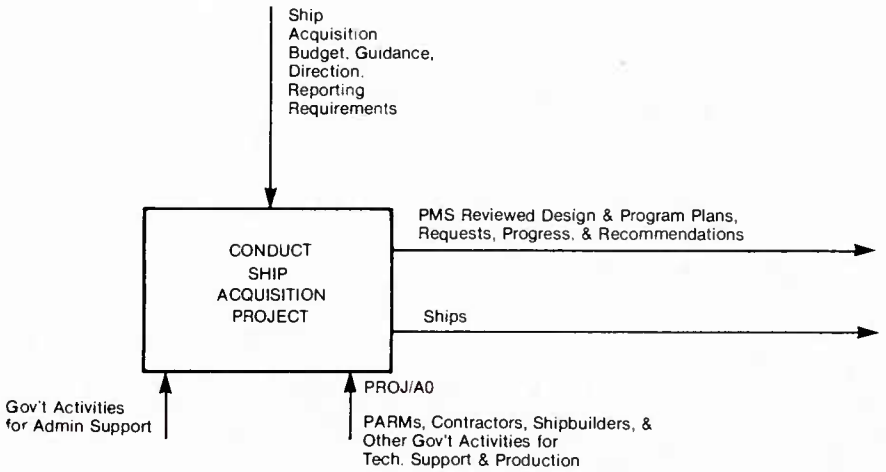
APPENDIX D

NODE:

TITLE: Structure of Organizations & Models (Typical)
Highlighting Projects/Programs

NUMBER:

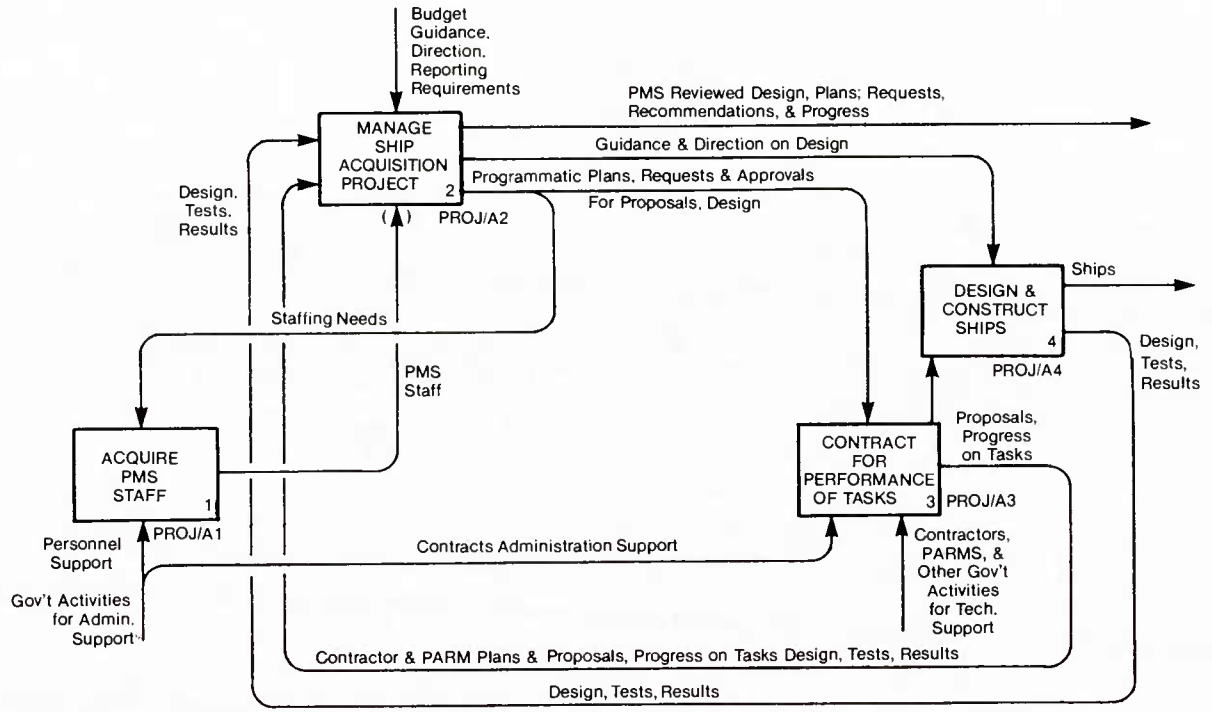




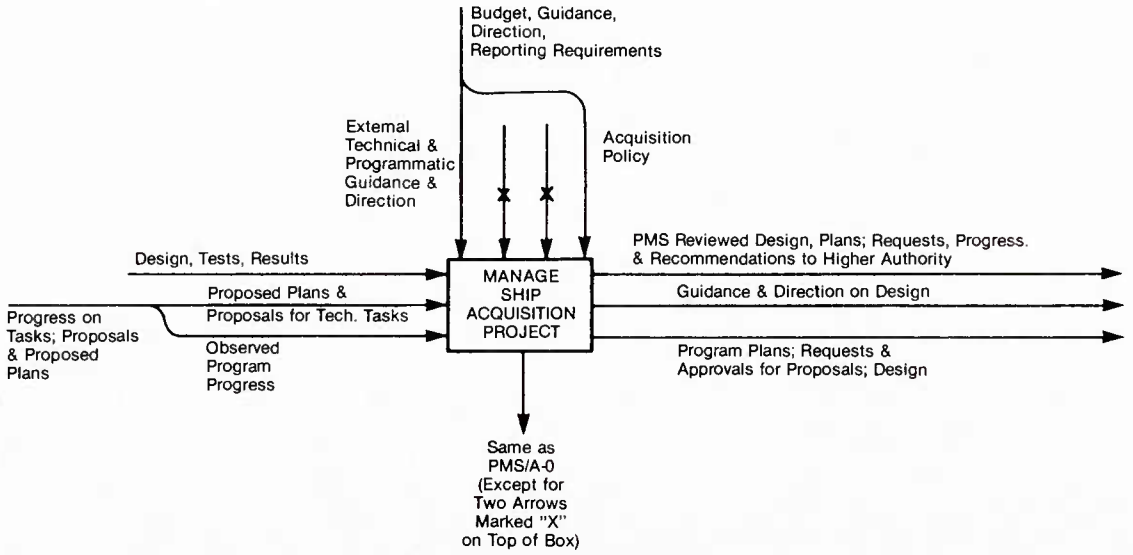
Purpose: to describe ship acquisition projects to understand the context of project management.

Viewpoint: composite of PM and all supporting organizations (PARMs, contractors, Personnel Div., & Contracts Admin. Div.)

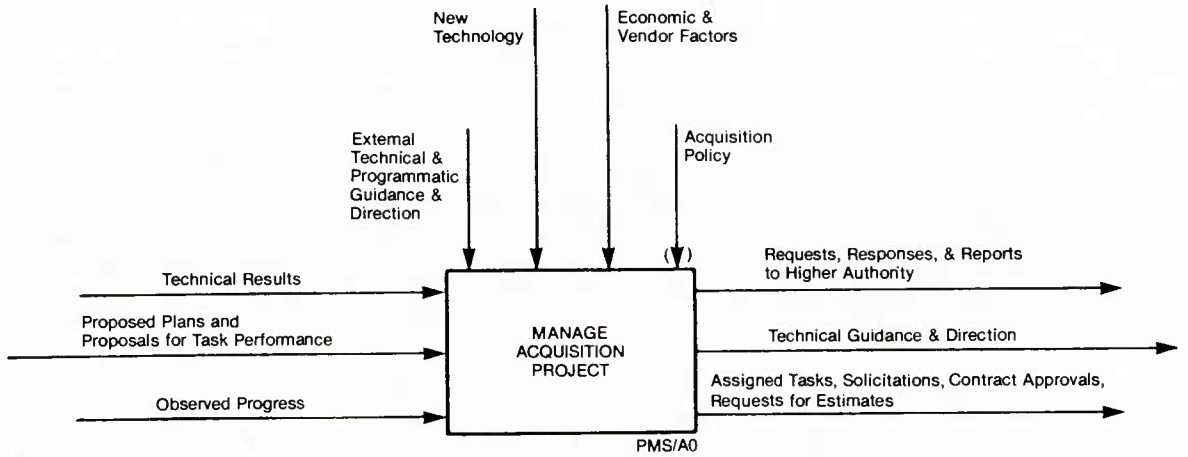
NODE:	TITLE:	NUMBER:
Proj/A-0	Conduct Ship Acquisition Project (Context)	



NODE:	TITLE:	NUMBER:
Proj/A0	Conduct Ship Acquisition Project	



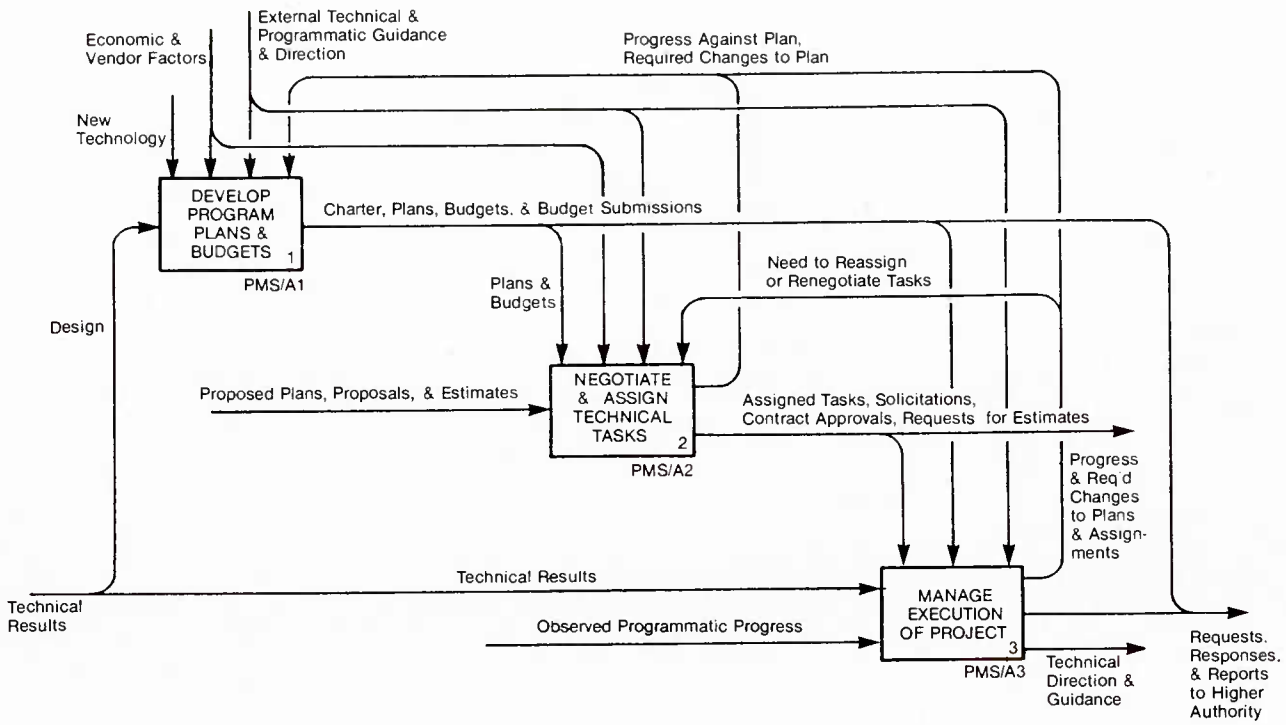
NODE:	TITLE:	NUMBER:
Proj/A2	Relationship to PMS Model	



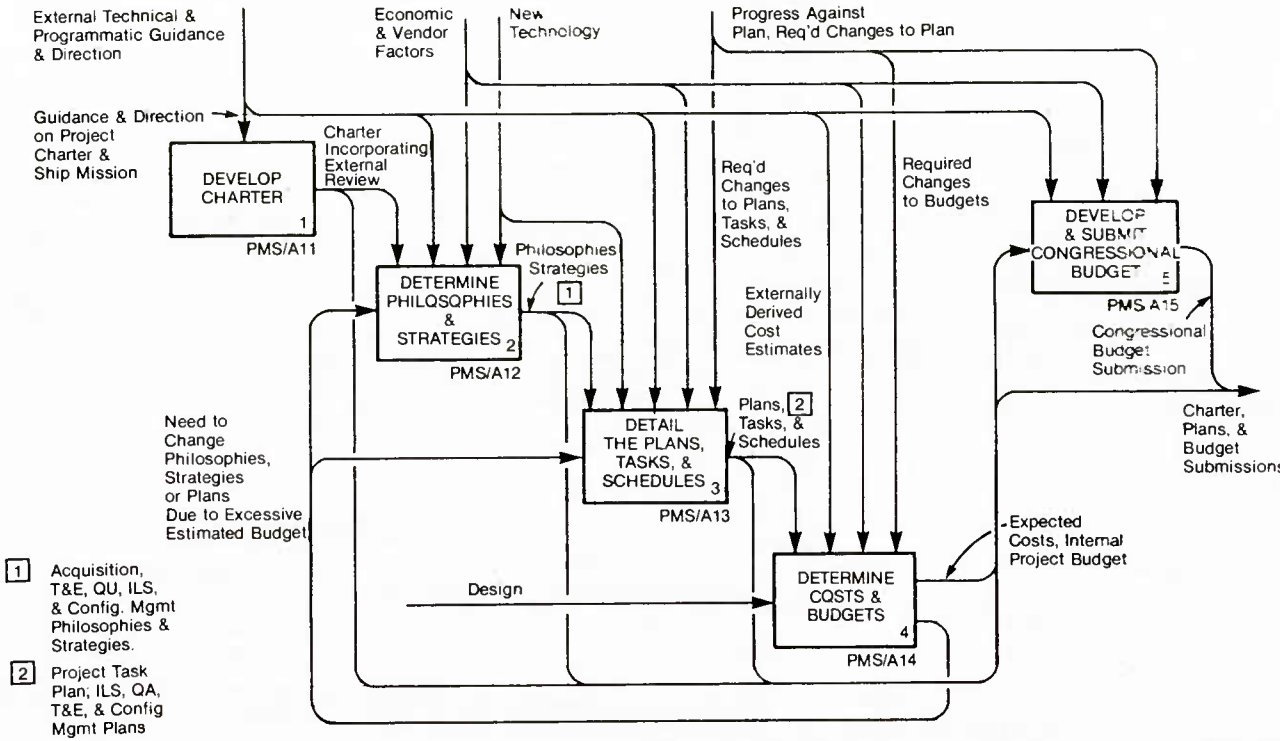
Purpose: to describe management of a program/project to allow integrated definition of areas of concern

Viewpoint: Project Manager

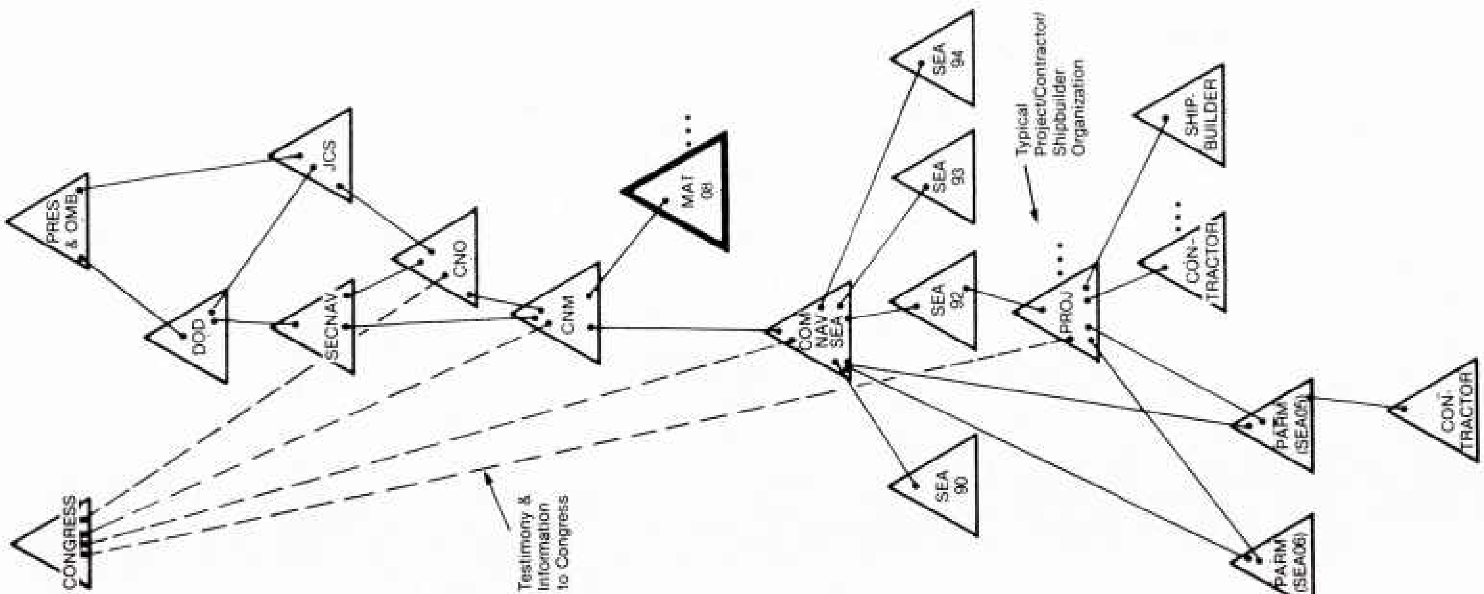
NODE: PMS/A-0	TITLE: Manage Acquisition Project (Context)	NUMBER:



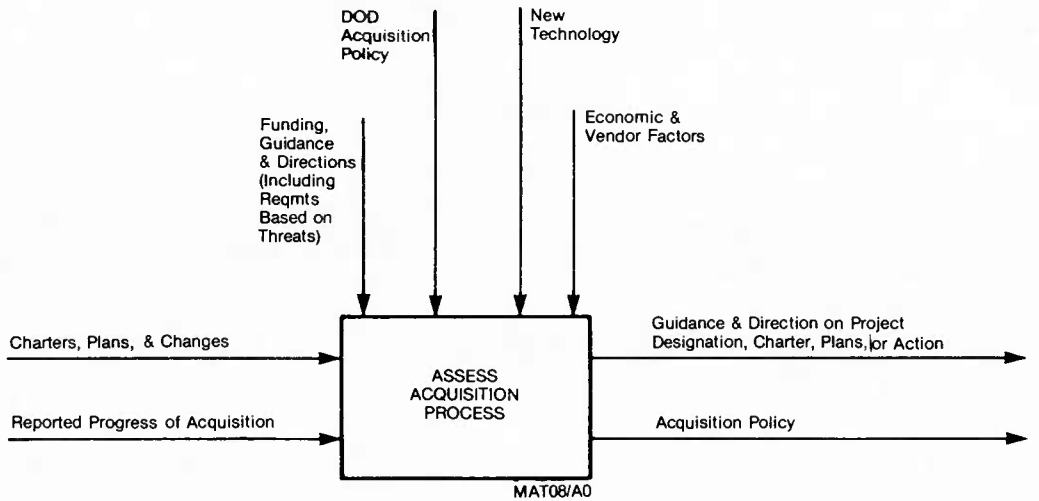
NODE:	TITLE:	NUMBER:
PMS/A0	Manage Acquisition Project	



NODE:	TITLE:	NUMBER:
PMS/A1	Develop Program Plans and Budgets	



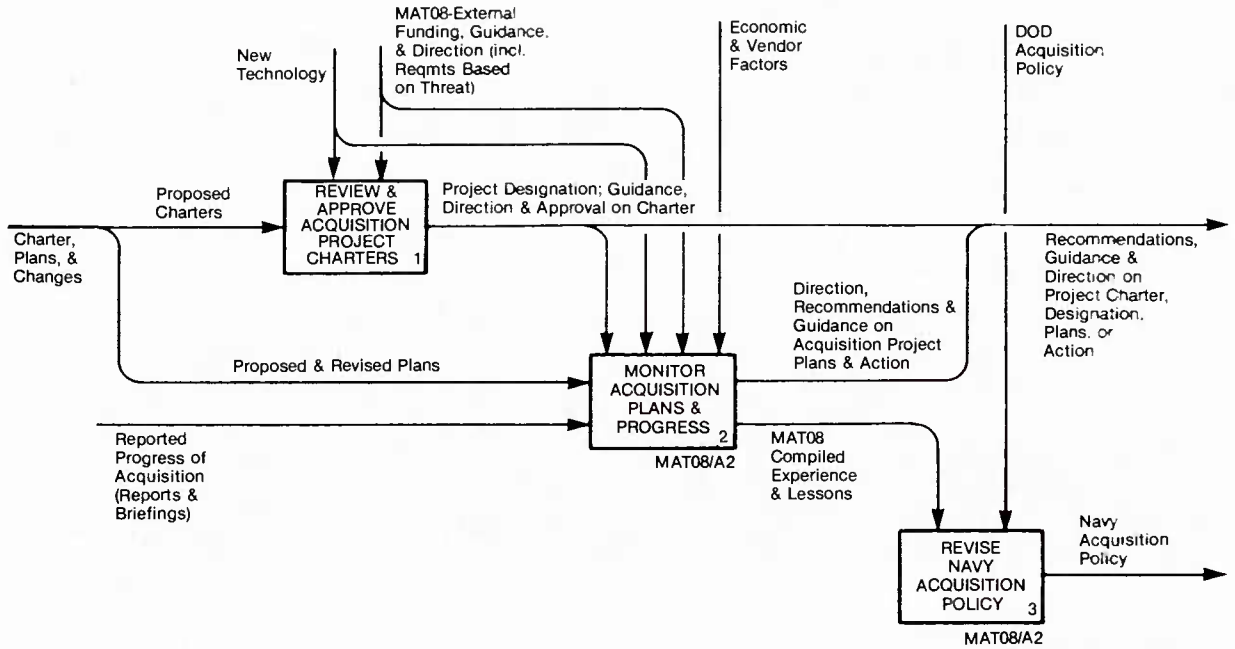
NODE:	TITLE: Structure of Organizations & Models (Typical) Highlighting MAT08	NUMBER:



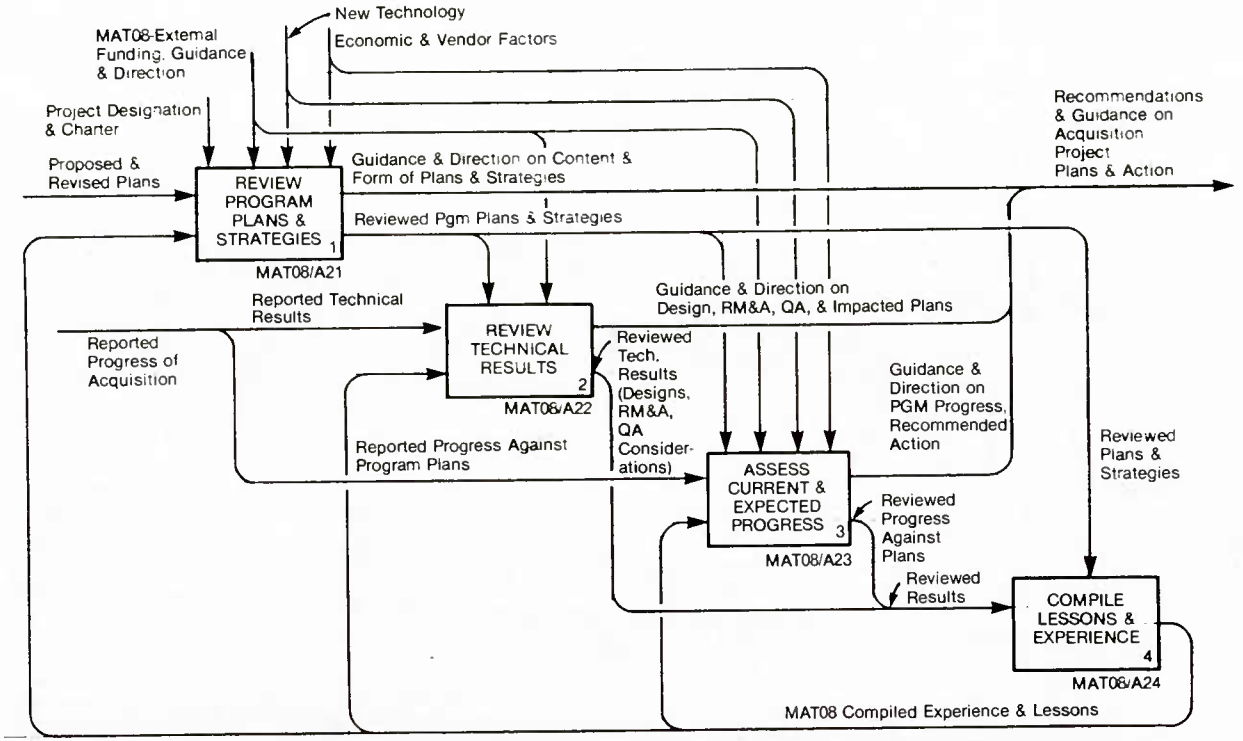
Purpose: to describe acquisition project plan & progress assessment to allow integrated description of areas of concern

Viewpoint: MAT08

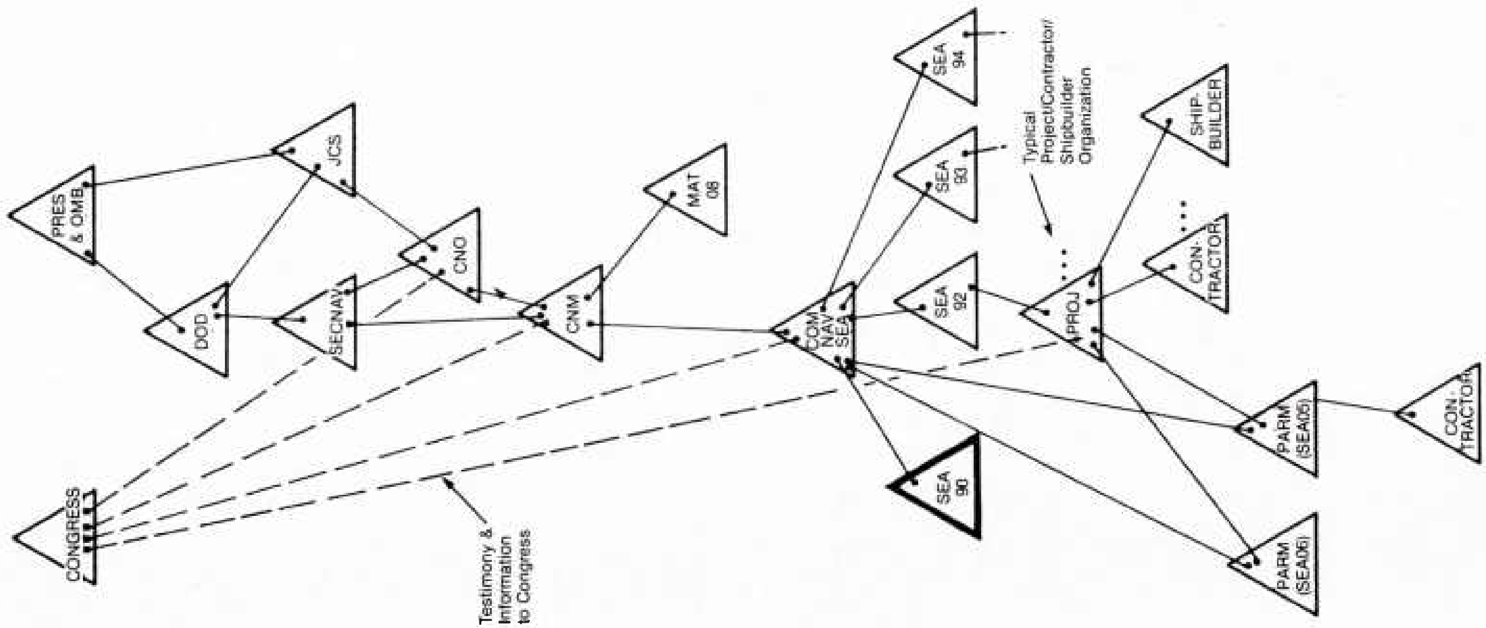
NODE:	TITLE:	NUMBER:
MAT08/A-0	Assess Acquisition Process (Context)	



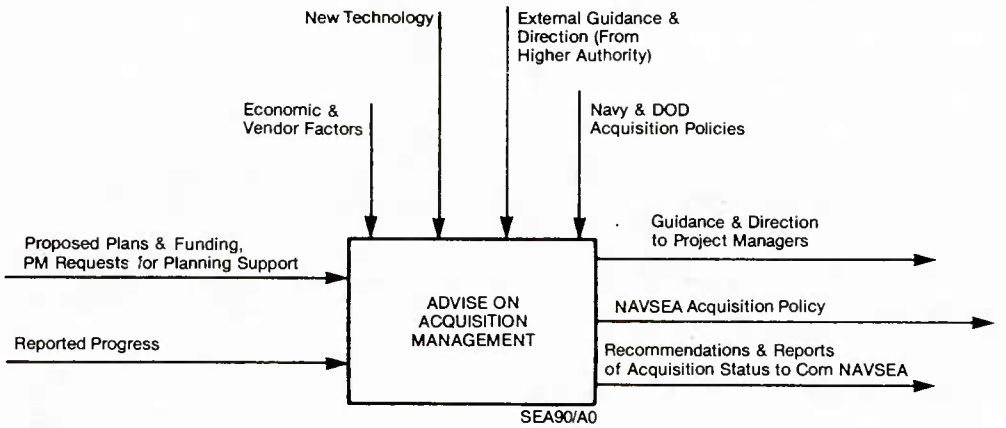
NODE:	TITLE:	NUMBER:
MAT08/A0	Assess Acquisition Process	



NODE:	TITLE:	NUMBER:
MAT08/A2	Monitor Acquisition Plans & Progress	



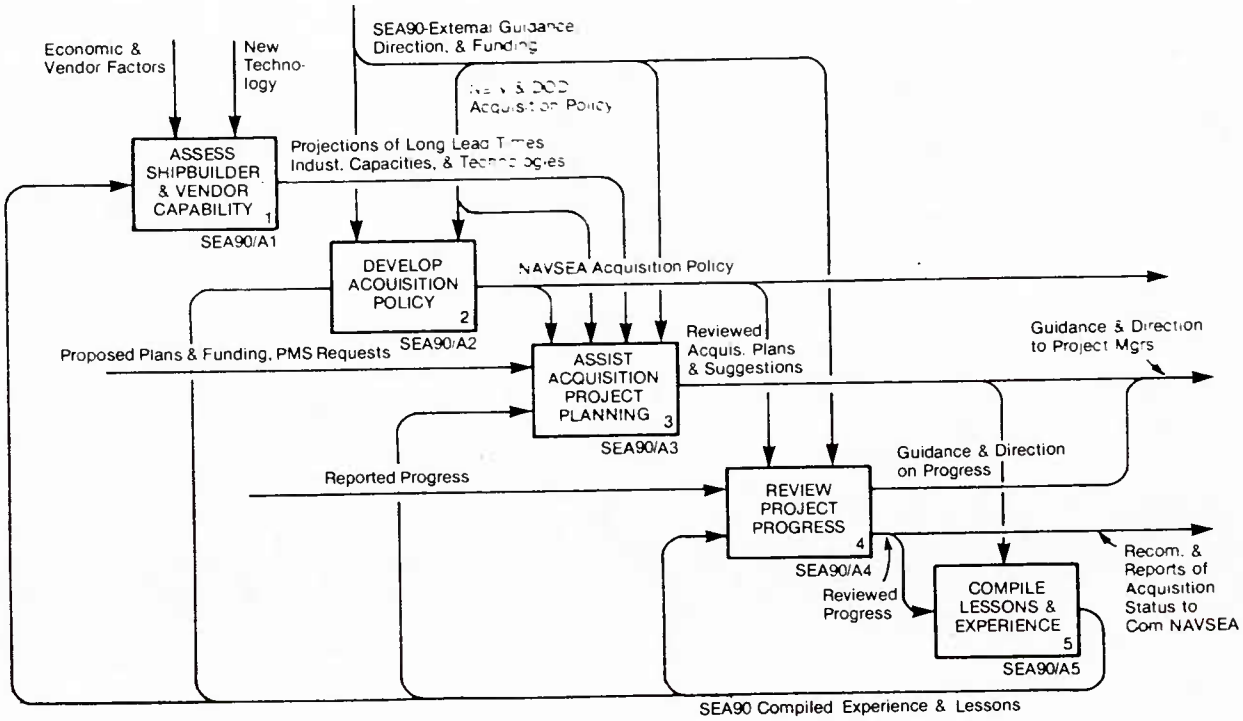
NODE:	TITLE: Structure of Organizations & Models (Typical) Highlighting SEA90	NUMBER:



Purpose: to describe acquisition planning and review to allow integrated description of concern

Viewpoint: SEA90

NODE:	TITLE:	NUMBER:
SEA90/A-0	Advise on Acquisition Management (Context)	



NODE:	TITLE:	NUMBER:
SEA90/A0	Advise on Acquisition Management	

AUTOMATED SUPPORT

FOR

NAVAL SHIP ACQUISITION MANAGEMENT

Appendix E

Submitted By:

ROH, INCORPORATED

APPENDIX E

CONTENTS

Appendix E

1. INTERVIEW METHODOLOGY

Over 40 upper and middle level managers were interviewed in order to establish the scope of the efforts required to provide improved acquisition management information support. The objectives of these interviews were to obtain from each respondent his perception of the acquisition environment(s), his definition of the acquisition functions with which he was concerned, and to determine his concerns and goals relative to his function and those functions closely related to his, or about which he was particularly well informed. Through a series of meetings with members of the Steering Committee and other key figures in the Naval Material Command and the Office of Naval Research, interview guidelines and questions were developed to elicit the desired information. The interview questions used during this phase of the project were purposely broad and general, so as to avoid narrowly channelling the interviewee's thinking. The emphasis was on discovery, with minimal "leading of the witness".

After the interviews began it was quickly discovered that the questions being asked were not yielding the kinds of responses which would satisfy the stated objectives. Consequently, over the periods of time the interviews were being conducted, the guidelines and questions were iteratively enhanced to obtain more meaningful responses or to take into account the particular interest or experience of the interviewee. Further, respondents were encouraged to volunteer their own ideas and concerns in a more informal manner. The evolution of the interview questions is apparent in the series of interview guidelines and questions which are presented in Attachments 1, 2, 3, and 4 hereto in the sequence in which they were developed. The later interviews were permitted to take the form of a more loosely-structured dialogue with interviewers asking follow-up, open-ended questions after initial informal statements by the managers

being interviewed. A stronger emphasis was placed on obtaining from interviewees their perception of what are the "soft spots" in the acquisition process. This approach yielded much better results. Considerable information about the functions and concerns of a sample set of contemporary acquisition managers was gained through this reduction in formality. However, the resulting accumulation of data was rendered less amenable to a structured tabulation than would have been the case if a set of standard questions had been rigidly adhered to.

All interviews were conducted on a not-for-attribution basis so that candid responses would be obtained. Consequently, specific individuals are not connected with specific interview responses herein.

In order to intelligently discuss current functions with interviewees, and to ensure that no significant current acquisition process functions were overlooked, the list of acquisition functions in Figure 1 was developed. It is an attempt to define the functions or disciplines which are collectively referred to as the "acquisition process".

01	LIFE CYCLE COSTING (LCC)	01 LIFE CYCLE COST 02 ACQUISITION COST 0201 UNIT COST 0202 TOTAL PROGRAM COST 03 OPERATING & SUPPORT COST 0301 UNIT COST 0302 TOTAL COST 04 ENERGY
02	DESIGN TO COST	05 INFLATION
03	INDUSTRIAL CAPACITY ANALYSIS	01 SHIPYARD WORKLOAD 0101 NAVAL 0102 COMMERCIAL 02 SHIPYARD CAPACITY/CAPABILITY
04	MATERIAL PROCUREMENT	01 GFE/GFI 02 LLT MATERIAL PROCUREMENT 03 CLAIMS AVOIDANCE 04 ADVANCE PROCUREMENT 05 SPD'S
05	SCHEDULING	01 PROGRAM SCHEDULE
06	ACQUISITION PLANNING/STRATEGY	01 SHIPYARD ALLOCATIONS 02 CONTRACT TYPES 03 CLAIMS AVOIDANCE 04 COMPETITION 05 RISK MANAGEMENT 06 DRAWING VALIDATION 07 FEASIBILITY STUDIES 08 CONCEPT STUDIES 09 LAND-BASED TEST SITE(S) 10 SCHEDULE 11 ILS 12 T&E 13 RM&A 14 SHIPBOARD MANNING/TRAINING 15 MASTER SCHEDULE NETWORK 16 COMBAT SYS. MGMT. PLAN 17 HUMAN FACTORS 18 PROGRESS/APPRAISAL 19 SHIP TRANSFER
07	ILS	01 MAINTENANCE PHILOSOPHY 02 MANPOWER/TRAINING PHILOSOPHY 03 TECHNICAL DOCUMENTATION 04 MATERIAL SUPPORT 0401 BACKUP SPARES 0402 ONBOARD REPAIR PARTS 0403 ROTABLE POOLING

Figure 1

08	RM&A	01	NEW EQUIPMENTS
		02	READINESS
		03	REDUNDANCY
		04	RISK EVALUATION
		05	DESIGN REVIEWS
09	T&E	01	DEVELOPMENT T&E
		02	OPERATIONAL T&E
		03	PRODUCTION ACCEPTANCE T&E
		04	GROOMING
10	ASU	01	OPEVAL
11	QUALITY ASSURANCE		
12	EXOGENOUS INFLUENCES	01	CONGRESS
		02	OSD
		03	OMB
		04	GAO
		05	SECNAV
		06	OPNAV
		07	ENERGY
		08	ECONOMY
		09	REQUIREMENTS CHANGES
13	FINANCIAL MANAGEMENT	01	BUDGETING
		02	ACCOUNTING
		03	COST CONTROL
14	POLICY CONFORMANCE REVIEW		
15	ENGINEERING DESIGN	01	CONCEPT FORMULATION
		02	CONCEPT DESIGN
		03	PRELIMINARY DESIGN
		04	CONTRACT DESIGN
		05	DETAIL DESIGN
		06	PRODUCEABILITY
16	CONGRESSIONAL LIAISON		
17	INFORMATION MANAGEMENT		
18	PROJECT MANAGEMENT	01	PROGRAMMATIC
		02	TECHNICAL
19	CONTRACT ADMINISTRATION	01	CLAIMS AVOIDANCE
		02	CONTRACTOR PERFORMANCE
		03	CONTRACT TYPES
		04	SOURCE SELECTION

Figure 1 cont'd.

20 CONFIGURATION MANAGEMENT

- 01 TRACEABILITY
- 02 CHANGE MANAGEMENT
- 03 DRAWING REVISIONS
- 04 CLAIMS AVOIDANCE

21 STANDARDIZATION

22 SAFETY

23 SECURITY

24 ENVIRONMENTAL IMPACT ASSESSMENT

(Figure 1 cont'd)

2. INTERVIEW FINDINGS

2.1 General Findings

As the project team progressed through the interviews, a number of common ideas and attitudes emerged, revealing a remarkably strong consensus on certain issues.

An early finding was the realization by the project team that even in the case of someone who has spent most or all of his professional career in ship acquisition, any one person is able to offer at best a limited perspective on the ship acquisition process with all its breadth and depth. That is to say, human beings simply do not live long enough and are too professionally mobile to have experienced all aspects of several acquisitions from all vantage points. The consequence of this is that the project team has had to do considerable correlation to tie these limited perspectives together into a cohesive fabric.

Another major finding is that in the acquisition community, as elsewhere, there is a general lack of appreciation that information, like people, money, and facilities, is a resource to be systematically managed. The interview questions about information required for decision-making and other functions generally elicited no meaningful response. It is quite clear that today's acquisition managers have generally not been educated in the principles of information management.

Another attitide commonly encountered was the reluctance of well-established acquisition organizations to welcome any changes to the way information is currently handled, such changes being seen as disruptive to existing practice. On the other hand, newly established organizations seem to have an unusually open mind about improved ways of managing information. This attitude difference is definitely relevant to choosing target implementation organizations later on, for information tools developed during the course of this project.

There was widespread agreement among the interviewees that the decisions made in the early stages of an acquisition (prior to DSARC Milestone I) are generally the most significant decisions made during the lifetime of an acquisition in terms of impact.

2.2 Findings Related to Interviewee's Environment

The interviews revealed an attitude which seems to be strongly and universally held, that being the attitude that, "I am competent to do the job to which I am assigned", and "I neither desire nor appreciate the meddling of those who are looking over my shoulder". Another way the same attitude is expressed is, "I really don't want 'help' from all those who say they are trying to help me do my job". The underlying fear is one of giving up control of one's influence over events to the party seen as the meddler. This attitude is not generally held toward other persons in one's immediate office, but rather relates to persons from other codes in the command or other commands.

There are two primary reasons for mentioning this pervasive attitude. One is that it is so widespread, and the other is that it results in people having a very possessive (and often selfish) attitude about the information under their control. This, of course, must greatly affect the design of any information tools which can facilitate sharing of information. The fact that these tools <u>can</u> facilitate sharing offers no assurance that they <u>will be used</u> to facilitate sharing of information. The best way to inhibit the impact of someone seen as meddling in one's business is to "stonewall" the meddler's requests for information.

This is clearly a problem in organizational behavior which presents both challenges <u>and</u> opportunities. Perhaps the availability of more

consistent, complete, timely and accurate information will gradually erode some of the barriers to sharing of information which people have erected to prevent embarrassing or confusing situations caused by the use of information which is incomplete, inaccurate, inconsistent or untimely.

On the other hand, it seems to be generally recognized that the "bureaucratic meddling" which goes on is simply an intrinsic feature of a peacetime bureaucracy which places great emphasis on risk avoidance.

Several of the interviewees expressed for both their immediate organization as well as their command, a desire for greater professional respect. This may well be the opposite side of the "meddling/monitoring" coin; greater professional respect would tend to reduce meddling by outsiders.

Last, the opinion was expressed by all the interviewees with project management experience, that to know in considerable detail the corporate condition of their shipbuilding contractors was essential.

2.3 Findings related to interviewees current function

The discussions with upper-level interviewees regarding their decision-making activities were interesting. All saw their decision-making as unstructured and largely reactive to external stimuli. Additional interviews of lower level people will probably show that the degree of structure of decision-making is inversely proportional to position level.

2.4 Findings related to concerns and goals

After the first few interviews were conducted, it became evident that the majority of concerns and goals fell into less than ten categories. After these categories were identified, an interview question (Attachment #4, last question) was developed asking the respondent to rank each category from 1 to 5, indicating whether improved information in that category was very valuable (5) to

not of value (1) to him.

The average ranking given each category is shown in Figure 2.

FUNCTION	Value of Having Better Information in This Area Ranking From 1 (not of value) to 5 (very valuable).
Acquisition Planning	
Systematic Project Histories	4.1
Change Management	4.8
Impact Analysis	4.1
Cost Estimating	4.6
GFE/GFI Management	4.2
Project Financial Management	4.2
Preparing Varicus Project Management Plans	3.0
Project Problem Management	3.0
Contract Administration	2.5
Perscnnel Administraticn	2.0

Figure 2

Since the aforementioned functions have been described only in terms of two or three words, it is appropriate at this juncture to elaborate on what is meant by these functional titles.

2.4.1 Acquisition Planning

An acquisition basically involves creating Program Plans and Technical Plans and then attempting to execute those plans. Program plans include a Ship Acquisition Plan, a Test and Evaluation Master Plan, an Operational Requirement, Ship Project Directives and other such management documents. Technical plans include ship design products such as drawings, specifications, and bills of material. The technical plans are supposed to evolve through a series of states referred to as baselines; for example, Conceptual Baselines, or Functional Baselines.

Owing to a number of factors, it becomes desirable and/or necessary to frequently effect changes to those plans. Program plans also undergo change, with specific revision efforts occurring largely at significant project review points.

The systematic, disciplined management of this change activity is what is meant by the term, Change Management.

This area, which received the highest ranking as noted in Figure 3-1, poses a tremendous challenge, as well as very substantial opportunity to impart greater efficiency and efficacy to the ship acquisition process. A skeletal concept for attacking this area is presented in Figure 3. Considerably more work is required to fully develop a methodology for change management.

The high ranking given to Systematic Project Histories was motivated by the interviewees' desires to have a systematically organized "corporate memory", which is regularly refreshed with recent history and which can be a major source of insight for contemporary acquisition managers planning future acquisition activity. Concern was

CHANGE MANAGEMENT

I. BACKGROUND

1) Change is inevitable; will it be actively managed or passively allowed to occur?
2) There are technical changes and programmatic changes.
3) Technical change equals baseline modification.
4) Authority to make and report changes must be clearly defined.
5) Data integrity must be respected or data sources will not be maintained.

II. PROBLEM

1) Ship definition, design, and construction is an extremely complex interaction of requirements versus constraints, involving many people over lengthy periods of time.
2) The responsibilities and motiviations of these people change during the process.
3) Communications among these people are significantly less than 100% effective.
4) Technology changes with time.
5) Leadership changes with time.

III. OBJECTIVE

Define a methodology which provides:

1) Translation of requirements to mission systems.
2) Mission systems to hardware systems.
3) Hardware systems to ship integration.
4) Feedback and recording of change.
5) Manage change from beginning of concept definition to final turnover of last ship.

IV. CHANGE MANAGEMENT METHODOLOGY

1) Describe top level requirement and ship mission statements

Figure 3

in discrete ship system hardware "packages". Packages must be stand-alone and must describe system integration interfaces.

2) These ship system hardware "packages" are organized in an equipment, sub-system, system hierarchy.
3) Ship cost, weight, size, endurance, constraints, etc., are defined in terms of the discreet ship system packages.
4) Maintain/update ship system "packages" as ship definition, design, and construction progresses.

Figure 3 cont'd.

expressed that lacking a systematically maintained corporate memory, lessons learned are lost and different projects work from different fact bases, creating an image for the Navy of inconsistency and unreliability.

Impact Analysis is the term given to the function which largely involves answering, "what if?" type questions. It is the element of acquisition planning which investigates potential program or technical changes in the earlier stages of their consideration.

The three elements of acquisition planning, namely Impact Analysis, Change Management, and Systematic Project Histories, are essentially the head, body, and tail, respectively, of acquisition planning. Impact Analysis has to do with potential changes, Change Management deals with managing all the detailed implications of any particular program or technical change, and Systematic Project Histories involve laying down an accurate track of what actually happened.

The initial round of interviews clearly points to Acquisition Planning as the area of highest interest.

2.4.2 Cost Estimating

The apparent reason for which the interviewees gave cost estimating a high ranking was a desire to more systematically maintain an easily accessed track of individual cost estimates with their attendant assumptions. Further investigation is required to confirm if, indeed, this is the reason for interest in this function. If it is, this function can be included as part of the methodology developed for maintaining Systematic Project Histories.

2.4.3 GFE/GFI Management

This term refers mainly to maintaining an accurate status of GFE and GFI in each acquisition project so the government can minimize project disruption due to late, incomplete, inaccurate or damaged

GFE/GFI. This is an area which is seemingly mundane, but one where acquisition managers express a desire to improve the Navy's performance.

2.4.4 Project Financial Management

The emphasis given this function appears to derive from a recognition that one of the essential classical elements of management is maintaining accurate budgets, journals and ledgers and preparing financial reports. If there is a problem in this area, it is that there is a tendency for each acquisition to invent (at considerable cost) its own unique system for financial management. This is a function with sufficient generality to strongly suggest the feasibility of developing one or more standard information tools to support financial management.

2.4.5 Preparing and Disseminating Various Management Plans

The interviewees expressed a concern about the amount of labor expended to prepare, revise, review and distribute the many programmatic documents involved in ship acquisition. This was frequently mentioned as an area significantly contributing to expensive costs and delays in the acquisition process.

It is quite clear that the largely manual methods currently in use in this function are costly and inefficient. The use of more contemporary information management methods would significantly enhance this function by relying much more heavily on processing this information by electronic vice manual means.

Given that preparing, revising and distributing the various program management plans is part of the acquisition planning function, and particularly the change management function, there is a logical basis for including the function discussed in this section under the broader area of acquisition planning.

2.4.6 Project Problem Management

There is general recognition that the typical acquisition mangers spends a substantial portion of his time managing the current list of problems. These problems can be technical or programmatic, but most always involve:

(1) Defining the problem from available data sources
(2) Correlating the problem with other related problems or occurrences
(3) Analyzing the problem
(4) Generating a corrective action
(5) Implementing the corrective action
(6) Verifying that the problem is solved

Given that at any time, an acquisition project frequently has hundreds of problems in various of the above stages, and frequently tasks numerous outside organizations to accomplish problem analysis, corrective action, etc., it is clear that a systematic information management discipline is required to stay on top of it all. Lacking any discipline of this sort, past acquisition projects have devolved into a reactive mode, having "lost the bubble" on who is doing what and when.

Recent successes with ADCAP (Acquisition Deficiency Corrective Action Program) have demonstrated the potential efficiencies which can be imparted to the acquisition process with a more disciplined approach to problem management.

2.4.7 Contract Administration and Personnel Administration

These two functions will be discussed together because they have many qualities in common in the eyes of the interviewees.

It was nearly a universal consensus that Contract Administration and Personnel Administration are functions which contribute greatly

to dealys and increased costs in the acquisition process. Acquisition managers tend to view these functions as "black boxes" called NAVSEA 002 and 02, with whom they have to interact to accomplish anything regarding personnel or contracts.

Comments about what to do about this problem, however, varied from "leave it alone, the problem is bigger than all of us", to, "let's keep track of their record, so we can embarrass them into a better performance", to, "let's get into those black boxes to see what can be done to improve things".

3. NAVMAT/NAVSEA EXISTING SHIP ACQUISITION DECISION PROCESS MODELS AND ALGORITHMS

Within the Naval Material Command and the Naval Sea Systems Command there are numerous data bases supporting various acquisition management functions. Of the 40 Management Information Systems listed in NAVSEA NOTE 5230 of 11 April 1980, which are related to the acquisition process, about 75% support ship acquisition decision-making to some degree. There are in addition a number of management information systems operated and maintained by NAVMAT or NAVSEA contractors which support the acquisition management process.

Nearly all of the data bases/management information systems noted herein are simply computerized filing systems and do not embody any significant degree of decision-making methodology. That is to say, use of ADP processes within the acquisition community is limited primarily to maintenance of reference files required in support of acquisition management. Only one system stands out as an integral part of a systematic formal decision methodology, namely the PBBS. Most decision-making algorithms can be considered to be non-automated, formal only to the extent they are in accord with broad policy directives, and supported by numerous manual and computer-based reference files. Since these algorithms are required in most cases to be in accord only with fairly general policy guidelines, the algorithms themselves change as different people rotate in and out of various acquisition management positions.

3.1 Following is a Partial Listing of Data Bases

Model/Algorithm	Sponsor or Customer
Defense Major System Acquisitions (A-109, DSARC, etc.)	DOD
PPBS (POM, FYDP, etc.,)	Navy Department
AEGIS MIS (PCS) Provides for detailed planning of AEGIS Program (IBM 370/168 at NIH)	PMS 400

Model/Algorithm	Sponsor or Customer
HEL Management & Technical Data System Program Control, contract status, and Technical Data Files (UNIVAC 1108, FAC, Corona, Cal)	PM-22/PMS 405
PMS 303 (PHM/MCM) MIS Operational and Technical Data for program and contract control (CDC 6700 & 600 at DTNSRDC)	PMS 303
PMS 383 Logistics Data Management System Management Tool for planning and controlling ship acquisition programs (CDC 6600/6700 at DTNSRDC)	PMS 383
Coordinated Ships Data Systems Planning, monitoring and reporting the production phases of the Navy shipbuilding and conversion program (UNIVAC 1108, CSC INFONET, Los Angeles, Cal)	SEA 071
Long Range Planning System Projects long range ship schedules, manpower, drydock, berthing requirements; reports for POM/FYDP (IBM 370/168, USDA WASH, DC; CDC 6700 etc., DTNSRDC)	SEA 071
Weapons System Acquisition Review	CNM
Selected Acquisition Tracking System	MAT 09H
Ship Acquisition Plan Outline and Ship Acquisition Plan	COMNAVSEA

Model/Algorithm	Sponsor or Customer
Combat System MIS Generate schedules, provides for updating and distribution of schedules and configuration matrices. (CDC 6500 at NSWC, White Oak)	SEA 06D
PHALANX Ship Installation Plan Integrates ship availability with PHALANX production (CDC CYBER-73 at UNA, McLean,VA)	SEA 62YD
Combat Systems Master Plan	COMNAVSEA
Ship Portable Electrical/Electronics Test Equipment Requirement List (SPETERL) Establish requirements for SPETERL. Plan and program to meet requirements. (Honeywell H2060 at SEAADSO)	SEA06C/MAT 04T
Ships Support Improvement Project-Logistics Data System (FFG-7) Processes LSA data for support Managers (IBM 360 at SPCC managed by NAMSO)	PMS 306/399
Integrated Logistics Support Plan	SEA 04L1
RM&A Program for Design,Development and Acquisition	SEA 902
Logistic Support Plan (FFG-7 Data Base contractor maintained) (Sperry SSM)	CSM/COMNAVSEA

Model/Algorithm	Sponsor or Customer
Material Planning & Programming System for Shipbuilding and Conversion (Navy) Establishes Master Equipment Lists, tracks GFE/GFI; produces budgets and financial reports; supports POM. Contractor maintained (CDC 6700 at DTNSRDC)	SEA 05M
New Construction Analysis Identifies and tracks material requirements. (IBM 360/370 at NIH)	SEA 63FM
Phased Outfitting Provisioning System Management of Phased Outfitting and Provisioning Programs for new equipment. (UNIVAC 494 at SPCC)	SEA 041
Procurement Action Status Report Monitor all procurement requests; remote update and inquiry. (IBM 370/165 at NARDAC, Arlington, VA)	SEA 0212
Procurement Report Control Provides statistical data on Contracts/Mods for procurement (IBM 370/165 at NARDAC, Arlington, VA)	SEA 02
Total Ship Test Program for Ship Production	06C2/05L2
Test and Evaluation Master Plan	COMNAVSEA
Test Documentation Index File Manage development of Test Programs and Procedures. Report status and problems in testing. (UNIVAC 1108 CSC-INFONET, Beltsville, MD)	SEA 93M

Model/Algorithm	Sponsor or Customer
Test and Evaluation (Schedule, Monitoring; Many contractor maintained management information systems)	Various
Navy Training Plans Provide MP&T Planners with advance planning information. (IBM 370/165 NARDAC Arlington, VA)	SEA 05L1C
Service Approval Status List Updated approval list for all NAVSEA projects. (NMCSA IBM 1401)	SEA 902/OPNAV 411
Fitting Out Management Information System (FOMIS) Monitor and display GFE/CFE. Provides baseline for SECAS. (U 494 SPCC)	SEA 041
COSAL Requisitioning and Status Procedure Provide support in ordering, monitoring and tracking of out-fitting material. (BURROUGHS T3-3500, OUTFIT SUPPLY ACTIVITIES AT NSCOAK, NORVA, CHASN)	SEA 04122
Acquisition Deficiency Corrective Action Program Creates, maintains and summarizes listings of the INSURV Master File. Manages resolution of discrepancies. Contractor - (ROH, Inc) Maintained (GE Maintenance, DEC Terminals)	PMS 399

Model/Algorithm	Sponsor or Customer
Deficiency Item Management System Support SUPSHIP, Newport News in managing resolution of INSURV discrepancies. (UNIVAC AC 1108 CSC-INFONET)	SEA 074/SUPSHIP, Newport News
CVN-68 Class Status of INSURV Discrepancies Support PMS 392 in managing resolution of INSURV discrepancies. (CDC 6700 at DTNSRDC)	PMS 392
Consolidated Change Reporting System Records basic data on changes from inception of ECP to adjudication of contract modification. (HONEYWELL 440-GSA, Atlanta)	PMS 392
Automated Data Base on GFE for Configuration Management. Contractor Maintained (SPERRY SSM)	PMS 399
HMR/ECP Data Base Contractor Maintained (VITRO)	PMS 399
Record of Changes (ROC)/SCN Semi-automated MIS for SCN contract changes. (NMCSA - IBM 360/65)	SEA 90R
Configuration Control Board Operations for Systems and Equipments	SEA 62T1

Model/Algorithm	Sponsor or Customer
Logistic Data Improvement Program Management Information Data Base Report Technical Manual Deficient (IBM 360 Model 91, APL)	SEA 05L3
Ships Technical Data MIS/Ships Technical Publication System (STEDMIS/STEPS) Prime data system for information about technical publications for use in ships. (STEDMIS IBM 360/0S, NSDSA & PDP -11/70, Port Hueneme)	SEA 05L/OP401
NAVSEA Active Contract Report and Completed Contract Report Information on contracts and Mods from date of issuance until closed out by purchasing office. (IBM 360/370 at NARDAC, Arlington, VA)	SEA 0212
Procurement Accounting and Reporting System (PARS) Provide financial information to enable management to execute and control programs. (IBM 360/65, IBM 270/165)	SEA 01P2
Cost Estimating Data Base Provides 6 cost estimating data bases to assist SHAPMs. UNIVAC 1108 CSC-INFONET)	SEA 017

Models/Algorithm	Sponsor or Customer
Program Review System Cost estimating and financial review system for the SCN appropriation (IBM 370, NARDAC, Arlington, VA)	SEA 010
Navy Cost Information System PPBS system providing data for Navy FYDP (IBM 370/165, NARDAC, Arlingotn, VA)	SEA 0102
NAVSEA Unified Vendor Evaluation/ Unsatisfactory Material Reporting (NUVEP/UMR) Vendor Performance System Provides information for management in material procurement decision-making process. (HONEYWELL H 6060 at PNSY, Ports., NH)	SEA 90
Research and Development MIS Tasks financial and technical information on NAVSEA R&D Projects. Develops RDT & EN budget. (IBM 360 at NMCSA, Arlington, VA)	SEA 003
Foreign Military Sales MIS Planning and Financial tracking and reporting (IBM 370/168 Dallas, TX) (Datapoint 2200 San Diego, CA)	SEA 0184

3.2 Following is a listing of these data systems catagorized by major functional area with notation as to who are the primary users, to indicate where the same information is flowing into different organizations.

o Ship Acquisition Planning

- Long Range Planning System (SEA 071)
  Customers: SEA 071/070, OP 43, NSY, SOS & SLD's.
- Ship Acquisition Plan Outline/Ship Acquisition Plan
  Customers: SEA 00, SEA 90, SEA 92/93 or 94.
- Coordinated Ship Data System (SEA 071)
  Customer: SEA 00, OSD, OMB, MARAD, CONGRESS.

o Integrated Logistics Support

- Integrated Logistics Support Plan (SEA 04L1)
  Customers: SHAPM, SLD, SEA 04 Codes.
- Logistics Support Plan (FFG-7)
  Customers: PMS 399, SEA 04 Codes, SEA 931
- Ship Support Improvement Program - Logistics Data System (FFG-7)
  Customers: PMS 306/399, SEA 04 Codes/SEA 931, NAVSEA MECH DET, NSWSES, NAVELEX, SPCC, PERA(CRUDES).
- PMS 383 Logistics Data Management Information System (SEA 05L3)
  Customers: PMS 383, SEA 05L1C, SUPSHIPS NOrleans, SDiego, Seattle, NSWSES, NAVSEACENPAC/LANT, Support Contractor
- Automated Data Base on GFE (PMS 399)
  Customers: PMS 399
- Material Planning and Programming for SCN (SEA 05M)
  Customers: SHAPM's, PARM's
- New Construction Analysis (SEA 63 FM)
  Customer: SEA 63FM
- Fitting Out MIS (SEA 041)
  Customers: SHAPM, NSY, SOS, ICP, PTD Review Activity.

- Phased Outfitting and Provisioning System (SEA 041)
  Customers: Acquisition Project Manager, SPCC, Contracting Officer, PESA.
- COSAL Requisitioning and Status Procedures (SEA 04122)
  Customers: Navy Supervisory Activities, Outfit Support Activity, Fitting out Activity, Naval Shipyard, Ships
- Ships Portable Electrical/Electronics Test Equipment Requirements List (SEA 06C)
  Customers: Procurement Activities, Shipyards, SOS, TYCOMS, Ships SOAP Teams.

o Combat Systems

- Combat Systems MIS (SEA 06D)
  Customers: NAVSEA, NWC, NSWC, NSWSES, NAVELEX, OP03/04
- Combat Systems Master Plan
  Customer: NAVSEA, NWC, NSWC, NSWSES, NAVELEX, OP03/04
- Phalanx Ship Installation Plan (SEA 62YD)
  Customers: PMS 404, SEA 05L1, OP35/43, SEA 01

o Equipment/Material Qualification

- NUVEPS/HMR (SEA 90)
  Customers: DCAS, NAVORDSTAS, NAVPROS, NAVSEA, NSYs, NUSW Eng Sta, NAVSSES, NSTRS, PERA(SS), SDCC, SUPSHIPS, NWS
- Approval for Service Use (SEA 902)
  Customers: SHAPMs, Systems Designers, OPNAV Field Activities
- RM&A Programs (SEA 902)
  Customer: SEA 902
- Selected Acquisition Tracking System (MAT 09H)
  Customers: SHAPMs, NAVMAT

o Testing Programs and Procedures

- TSTP/SP
  Customers: SEA 93, PERA(CRUDES), NSYs, SOS, TYCOM, SHIPSFORCE
- TEMP
  Customers: SEA 93, PERA(CRUDES) NSYs, SOS, TYCOM, SHIPSFORCE
- T&E
  Customers: SEA 93, PERA(CRUDES), TYCOM, SHIPSFORCE
- Test Documentations Index File (SEA 93M)
  Customers: SEA 93, PERA(CRUDES), NSYs, SOS, TYCOM, SHIPSFORCE

o Acquisition Deficiency Correction

- ADCAP (PMS 399, PMS 383, SEA 93X)
  Customers: PMS 399, SUPSHIPS, SEA 90, 93, TYCOM, PMS 383, SEA 93X, SEA 03
- DIMS (SEA 074)
  Customer: SEA 074, SUPSHIPS Newport News, SUPSHIPS
- CVN 68 Class INSURV Deficiency Support (PMS 392)
  Customer: PMS 392, SUPSHIP, SEA 94, TYCOM

o Change Control

- ROC/SCN (SEA 90R)
  Customers: SEA 90, SUPSHIPS, SHAPMs, NAVSEA CONTRACTS DIRECTORATE
- Consolidated Change Reporting System (PMS 392)
  Customers: PMS 392, SUPSHIPS Newport News, TYCOM
- HMR/ECP Data Bases
  Customers: SHAPMs, SUPSHIPS, TYCOM
- Change Control Board Operations
  Customers: SHAPMs, SUPSHIPS, TYCOM

o Technical Documentation

- STEDMIS/STEPS (SEA 05L)
  Customers: Fleet, PERA, SEA 05L, NSDSA, SHAPMs, SLDs, PARMs, SUPSHIPS, NSYDs, NETC, NAVSEA CODES
- Logistics Data Improvement Program MIDB (SEA 05L3)
  Customers: SEA 05L33, NSDSA, Cog Engrs.

o Cost Accounting and Estimating

- PARS (SEA 01P2)
  Customers: OPNAV, NAVCOMPT, CNM, SYSCOMS, NRFC
- Cost Estimating Data Base (SEA 017)
  Customer: SHAPMs
- Program Review System (SEA 010)
  Customers: SYSCOMS, OPNAV, DOD, CNM
- Navy Cost Information System (SEA 0102)
  Customers: SYSCOMS, OPNAV, DOD, CNM

o Contract Management

- NAVSEA Active Contract Report & Completed Contract Report (SEA 0212)
  Customers: HQ and Field Support Activities
- Procurement Reporting Control (SEA 02)
  Customers: NAVMAT/NAVSEA
- Procurement Action Status Report (SEA 0212)
  Customers: NAVSEA Procurement Activities and Managers.

4. DECISION MODEL AND DATA BASE DEFICIENCIES

Our research has identified five significant deficiencies regarding decision models and data bases in the acquisition process.

A very fundamental deficiency is that most extant decision algorithms relevant to various acquisition management functions are non-automated, generally constrained only by broad policy directives, and therefore subject to constant change as personalities change within a given acquisition function. Only the PPBS process stands out as a clear exception to this condition. PPBS demands adherence to a clearly defined sequence of information submission, decision and aggregation procedures. Second, nearly all uses of data processing techniques within acquisition management functions focus entirely on maintenance of files of reference data rather than serving as an integral part of a systematic decision-making procedure, as discussed earlier.

A third area of deficiency is the lack of automated impact analysis modules having access to various reference files which would permit managers to answer the "what if" type of questions regarding impact on their program of alternative changes under consideration. The need for this generic category of information tool is addressed in the main body of our report.

Fourth, a widely acknowledged deficiency is the failure to systematically capture and record for posterity the significant data elements which constitute a history of each acquisition project. Again, this is addressed in the main body of our report.

Lastly, since the existing set of acquisition-related data processing applications were permitted to be created in the absence of any corporate "concept design" for information management, the degree of compatibility and integration among them is nil. Most of the existing data bases were created by individual SHAPMs, or by individual functions with NAVSEA 02, 04, 05, 06, and 07, generally without

regard for requirements outside the immediate code creating the system. Further, from SHAPM to SHAPM there has been considerable "reinvention of the wheel". The listing of existing data systems in the previous section includes over a dozen systems within various SHAPMs considered by each SHAPM to be all or part of his "SHAPM MIS". The same phenomenon exists among the PARMs. NAVSEA is spawning a continually growing population of data bases designed to serve various parochial interests, generally being designed and implemented without regard for the issues of compatibility and redundancy. We are not suggesting that a standard SHAPM MIS could be designed which meets the requirements of all SHAPMs. What is both possible and advisable, is to constrain these developments to remain within a concept design established on a command basis to ensure maximum compatibility among sub-systems. We detail design our ships within constraints created during concept design and apply the principles of design integration to ships. Exactly the same discipline is urgently needed to create a concept design for a system to manage NAVSEA's acquisition information. Then compatible sub-systems could be designed and implemented to support the various sub-functions within the command. These various information management tools, when made available to various NAVSEA offices, would serve as building blocks for their individual, uniquely different data systems. This would preclude some of the unnecessary redundant development currently existing.

The integration and compatibility referred to here is a necessary prerequisite for achieving the change management capability referred to in the main body of the report which will facilitate more systematic follow-up to decisions made to effect changes to an acquisition program.

INTERVIEW QUESTIONS

A. Revelatory Portion of Interview

- To understand the acquisition environment
  - o What environmental factors are critical to the success of your function?
  - o What significant information sets do you generate for use outside your function?
  - o What outside information sets do you depend on to perform your function?

- To understand functions
  - o Would you summarize your function?
  - o Would you categorize the decisions you make?
  - o What key internal information sets are required to support your functions/decisions?
  - o Do you consider each of the above mentioned information sets relevant and accurate?
  - o What factors are critical to the success of your function?

- To understand concerns
  - o What if any, decisions/functions are particularly difficult due to a lack of available, accurate or timely information?
  - o Would you enumerate any significant concerns or goals you have with regard to your function?

(a) What priority or urgency do you attach to any comprehensive attempt to improve the availability, accuracy or timeliness of information used by the acquisition community?

B. Confirmatory Portion of Interview

- Test each of the hypotheses and corollaries enumerated for completeness and correctness.

HYPOTHESIS I

Information of interest to the acquisition community is included in the following categories:

1. Physical configuration data
2. Financial data
3. Schedule data
4. Resources data
5. Logistic Support Data

COROLLARIES:

A. The above data should be cross-categorized to include:
   1. Historical data
   2. Variance data

B. Most financial, schedule, and resource data could be keyed to physical configuration data.

C. Acquisition managers at the project manager level and above deal with most acquisition functions on a parametric basis (cost, schedule, technical performance, risk, principles of acquisition strategy).

HYPOTHESIS II

A comprehensive need exists for "acquisition planning" and "impact analysis" tools.

COROLLARIES:

A. These tools require a corporate memory which includes project histories.

B. This need exists primarily at the project manager level and above.

EXPANDED LIST OF QUESTIONS

All numbered questions correspond to "revelatory" questions shown in enclosure 2. Lettered questions are specific examples or follow-up questions and can be further refined according to the interview respondent's interests.

To understand the acquisition environment

1. What environmental factors are critical to the success of your function?

    (a) Do these factors derive from higher authority (such as Congress, SECDEF), or are they associated with subordinate or contractor organizations? Describe them.

    (b) Are any of these factors policies set by higher authority? Describe.

2. What significant information sets do you generate for use outside your function?

    (a) Describe the information you produce for higher authority.

    (b) Describe the information you produce for subordinate or contractor organizations.

    (c) Is this information informal (spoken) or formal (written)? If formal, is there a policy or directive stating a requirement for it?

    (d) Identify the information by document name (if any) and logical content.

(e) Describe your perception of the use this information is put to by the recipient.

(f) What is the source of the information you produce for external use, or how do you develop it?

3. What outside information sets do you depend on to perform your function?

(a) Describe the information you receive from higher authority.

(b) Describe the information you receive from subordinate or contractor organizations.

(c) & (d) Same as 2 (c) & (d).

(e) To what use do you put this information, i.e., what do you do with it or what decisions are based on it?

(f) How did the source develop this information?

To understand functions

4. Would you categorize the decisions you make?

(a) Describe the decisions you make, their effects, and the information you need to make those decisions.

(b) Are these regularly recurring decisions or random?

(c) Are these decisions made because your organizational charter requires it or because you believe it is necessary to perform your function more effectively?

(d) Are these decisions well defined in terms of the state of the needed information or are they based on experience and an ill-defined set of factors?

5. What key internal information sets are required to support your functions/decisions?

(a) What information do you maintain, privately within your function or organization?

(b) What do you do with this information? Is it used in decision making or purely for assimilation into externally sent information?

(c) What level of privacy or security is appropriate for this information?

(d) Describe the information in terms of its name (if a document or a formal or informal file) and its content (logical meaning). Is this information on paper or in your head?

6. Do you consider each of the above mentioned information sets relevant and accurate?

(a) Do you maintain information because you need it for your purposes or because you are directed to maintain it, or both?

(b) How much concern is there about its accuracy and timeliness?

(c) How have you determined that the information is inadequate?

(d) What adjustments do you make when you use inaccurate/untimely information?

7. What significant documents do you generate or approve for internal use?

(a) Relate this to question 5(d).

8. What factors are critical to the success of your function?

(a) Relate this to questions 1(a) and (b).

(b) Do you have any control over any of these factors? Describe.

(c) Are any of these factors related to facilities and resources at your disposal? Describe.

9. What decisions/functions are particularly difficult due to a lack of useful information?

(a) What effect does inadequate/untimely information have on your decision making? (Relate to 6(d).

(b) If the information were available for your use, would it be developed by you or within your organization or would it be supplied by external sources? Describe the source if external.

(c) Describe the content of the information you need.

(d) How do you currently make do without the information?

10. Would you enumerate any significant concerns or goals you have with regard to your function?

    (a) Among those difficulties you expressed, which of them is due to the fact that logically what's being done is difficult, and which of them is due to inadequate support mechanisms (implementations such as staff with calculators or computer tools)?

    (b) Are there any goals you have regarding a better way to perform your function?

    (c) Are there any goals you have regarding increasing or decreasing involvement with higher authority?

    (d) Are there any goals you have regarding your dealings with subordinate or contractor organizations?

INTERVIEW GUIDELINES

Gather Data on:

- Function and Responsibilities
- Procedures/Processes in Use
  - Decision-Making
  - Reviewing
  - Controlling
  - Planning
- Problems/Concerns
- Potential Areas of Automation
- ADP Systems Currently in Use
- Information Sources
- Information Uses
- Attitude Toward Automation

Interviews will be conducted with varying types and levels of people. Therefore, questions will fit background and qualifications of individuals concerned.

Interview questions will be modified to suit the position and qualifications of the interviewee. Each interview will be arranged ahead of time by appointment and will normally be held to one hour. Frequently, multiple interview sessions will be held with the same individuals.

Early during each interview the scope and purpose of the interview will be explained as fully as possible. Each interviewee will be assured his responses will not be identified with him by name. At the end, a summarization of the main points of the session will be made.

TYPICAL INTERVIEW QUESTIONS - FIRST ROUND

1. IDENTIFY AND RESEARCH EXISTING DOCUMENTS

   1.0 Can you identify any documents relevant to the acquisition functions we are discussing?
   1.1 Referring to certain documents, do you consider them relevant and accurate?

2. IDENTIFY SENIOR MANAGEMENT FOR INTERVIEWS

   2.0 Do you wish to suggest other senior management executives for interview?

3. ESTABLISH ACQUISITION ENVIRONMENT

   3.0 What documents do you generate?
   3.1 What factors are critical to the success of your organization?

4. DEFINE BROAD ACQUISITION FUNCTIONS

   4.0 What decisions do you make?--Or support as a participant?
   4.1 What information is used to support these decisions?
   4.2 What are the sources of your information?
   4.3 What documents do you generate?
   4.4 What factors are critical to the success of your organization?
   4.5 What information is of interest to you?

5. IDENTIFY CONCERNS AND GOALS

   5.0 What are your top five concerns?
   5.1 What were your concerns six months/year ago?
   5.2 What decisions are particularly difficult for lack of information?

5.3 What information do you need that you don't receive?

5.4 What information do you receive that you don't need?

6. IDENTIFY OTHER PEOPLE TO INTERVIEW

6.0 Do you wish to suggest any subordinate personnel for interview?

7. FUTURE

7.0 What ADP systems exist which relate to your function?

7.1 What areas do you see as having potential for automation?

7.2 What existing policies/procedures could/should be changed?

Would you please summarize your function?

What environmental factors are critical to the success of your function?

What internal factors are critical to the success of your function?

Could you please review in your mind the more significant decisions you have made during your tenure in this position, and list for us the five or so most important ones?

a) Can you identify for us the information you used at the time to make those decisions?

b) Can you identify for us any additional information you didn't have at the time, but wished you did have?

What concerns/goals do you have regarding your function?

It has been suggested that having too few people to perform a function can be offset by improving via other means the information available. Do you agree or disagree?

Given the consensus that ship acquisition takes too long, what parts of the process can you point to where some of the more significant delays occur?

a) Which of these functions would be decreased in importance during a period of significant mobilization?

Some feel that the earlier stages of an acquisition are where the more significant decisions are made and, therefore, that is where improved information will have its greatest value. Do you agree or disagree?

Certain functions in the acquisition process have been mentioned frequently by people we are interviewing, as areas potentially attractive to attempts to improve available information. Would you please give us your opinion as to how valuable it might be in each of these areas if we were able to provide better information?

FUNCTION	Value of Having Better Information in This Area Ranking From 1 (not of value) to 5 (very valuable)
Acquisition Planning	
Systematic Project Histories	
Change Management	
Impact Analysis	
Cost Estimating	
GFE/GFI Management	
Project Financial Management	
Preparing Various Project Management Plans	
Project Problem Management	
Contract Administration	
Personnel Administration	

Attachment 4

F. Appropriate Technology and Prototype Recommendations -- Authored by CCA

F.1 Introduction

This appendix reviews high level information requirements of naval ship acquisition management, describes directly applicable technologies, and presents a prototype system concept. The prototype system will enable the Navy to experiment with the technology in the near term, test its utility in the acquisition management environment, and make informed decisions concerning its full scale implementation. The recommended system will:

a. provide access to a large pool of data relevant to all aspects of acquisition management;
b. present the data in forms that are far more usable -- for decision making -- than has been possible before; and
c. provide tools that assist managers in applying the data to practical, everyday decisions.

We believe that the combined effect of these capabilities, realized in an integrated system design, will be a qualitative change in the practice of decision making at the strategic and policy levels of the acquisition community.

This volume, Appendix B, has been prepared by Computer Corporation of America (CCA) as a supplement to the draft report entitled Automated Support for Naval Ship Acquisition Management, (September 5, 1980). That main report was drafted jointed by CCA and ROH, Inc. This volume, the main report, and an Appendix A prepared by ROH will be combined as soon as possible and submitted in final form as a single document.

Taken together, Appendices A and B comprise a response to a written request from the Office of Naval Research.* Appendix B responds specifically to two points in the ONR request:

- "High level information requirements as a reflection of data retrieval and presentation of possibilities afforded by advanced computer technologies, [and]
- Recommendation on prototype implementation, and experiments relevant to assessing quality and relevance of advanced MIS concepts; e.g. hardware, software, data."

(Appendix A is intended to respond to all other points in the ONR request.)

* Letter from M. Denicoff, Office of Naval Research, October 22, 1980, reference number ONR:437:MD:cds.

F.2 Key Requirements and Applicable Technology

Senior acquisition management faces two problems in making effective acquisition decisions: fragmentary information and complexity in the inter-relationship of acquisition factor. The technology to address these problems exists and has been demonstrated in government, military, and commercial application.

This section discusses the high level information problems associated with acquisition planning, identifies some requirements for a solution, and describes the graphics, decision-support, and data management technology that can be applied to these problems with near-term results.

F.2.1 The Problem

In the interviews conducted in this project, management and their staff acknowledged that reams of data are available. However, no Navy-wide scheme exists for coherent systematic collection of information for senior navy acquisition managers. Information collected by various SHAPMs differs in form, depth, and content; this is also the case for SUPSHIPs and PARMs. In addition, the information is fragmentary and patterns in collected data are not repeated often enough to be recognized. Because of this, complex relationships among acquisition factors often go undiscovered. This latter problem is exacerbated

by the fact that resource tools are not readily available to manipulate the data into forms in which patterns might emerge.

Another difficulty in senior decision-making is that, while simple relationships are understood and can be exploited in making some projections, more complex relationships are less well understood. Complex, multi-factored projections are therefore unattainable or unreliable. For example, the capability exists to estimate the task schedules, given a task dependency chart (e.g., PERT, CPM) and a resource pool (e.g., shipbuilding facilities, manpower). The capability to select allocation of resources (e.g., several shipbuilding facilities, manpower) across several projects (each having tasks described by a task dependency chart) and to minimize the total schedule duration is more difficult to obtain.

F.2.2 High Level Information Access and Manipulation Requirements

Three major requirements exist for solutions of these problems. First, data from different sources must be collected and transformed into information by senior acquisition management. Second, tools must be provided to management that present the information in ways that

- reveal the current state of acquisitions, and

- reveal -- perhaps through historic evidence -- the (potentially complex) relationships among various factors that led to the current state.

Third, tools must allow modeling of these interrelationships for the purpose of projecting the effects of various acquisition alternatives.

The first major requirement -- collection of information for management -- can be satisfied with automation in one of three ways:

1. A new database is created for senior management within SEA90 and/or MAT08. Its contents are manually generated by SEA90 or MAT08 staff who observe and record pertinent data. This approach is costly, lengthy, and risky. A *priori* knowledge of what to collect is required.
2. A new database is created with distinct areas of the database private to the various SHAPMs, MAT08, and SEA90. Overlapping areas of the database provide for shared information. This is discussed in Section 5 of the main report. This approach requires a lengthy startup to build a significant amount of data.
3. Data currently available on various SHAPM, SUBSHIP, PARM, NAVSEA, and NAVMAT databases through dialup or network facilities is extracted (with permission) and reformatted. The reformatted data is stored in NAVSEA or NAVMAT databases specifically intended for storage

of information relevant to senior management. This approach makes use of systems already operating and data already available; the approach can yield results within six months to a year.

It therefore appears that, for near term results, heterogeneous distributed data access is required. (A fourth approach, a complete heterogeneous distributed data management system, is not currently within the technology.) Heterogeneous distributed data access technology is discussed shortly.

The second requirement, information presentation tools, mandates a set of facilities for reorganizing, transforming, tabulating, displaying, selecting, and categorizing data. These tools are generic, applying to most decision-making environments, as would a calculator. These capabilities can be provided by decision support systems technology, particularly well when coupled with graphics interface technology.

The third major requirement for modeling can also be provided by decision support systems technology. Many of these capabilities would be oriented toward acquisition management.

An implied requirement is that these tools and data be directly available to acquisition managers and staff, i.e., without a data processing specialist as an intermediary. This requirement can be solved by an appropriate man/machine interface, the technology for which exists.

F.2.3 Technology Addressing Those Requirements

F.2.3.1 Graphics-Based Man-Machine Interfaces

Recent advances in computer graphics technology have made it possible for a wide range of users to communicate effectively with computers. Hardware technology now includes higher resolution displays, color, graphics capability (beyond simple character displays), and touch-sensitive screens, all at lower cost. Software advances now allow direct view of the data in a database (by predefined transformation of data values to images) and graphic manipulation of data, all without computer oriented command languages.

In support of acquisition management, an automated support tool could be constructed with a graphics interface. The terminal hardware could have a touch-sensitive color screen with good resolution, an attached platter or hard copy device for permanent copy of the screen, a keyboard for necessary textual communication, and a light pen, tablet, or joy stick for more precise cursor positioning or third dimension (zoom) control. The software supporting this terminal would provide acquisition manager staff (the end users) with a means for selection of commands: these means can be live commands, one of which is selected by cursor position, or can be labeled boxes presented on the screen to be picked by touching. The

command processor then invokes the desired function.

One way to make the system more "user-friendly" is to provide all functions with a standard user interface. A graphic interface could be constructed as follows: Once involved, a function requests its arguments (parameters) by presenting labeled boxes on the screen. The user keys in required values and touches the box the value is associated with. The value moves into the box, and this procedure is repeated until all necessary parameters are specified. Parameters can be changed by entering a value and touching the previously filled-in box. Execution begins upon command. Upon completion, the function arguments can be presented so the user can modify parameters and re-execute the function. In addition, if parameters can only have a limited number of values, these values can be presented for touch-sensitive or cursor selection.

The results of executing a function can be displayed in a form closely associated with the problem. Functions can therefore produce bar charts, histogramy images, tables, or text. Functions can be designed to present information in the manner most revealing to the user.

Such interfaces offer several advantages beyond that just mentioned. First, such systems can be made self-teaching, in that little instruction is needed to get started and no instruction is needed once the user understands the standard graphic interface. Second, training time is short and minimal expense is incurred in training

and refresher courses. Third, the rate of errors in communicating between man and machine is reduced because keyboard interaction with text-based command procedures is eliminated -- where possible, correct choices can be presented for touch sensitive or cursor selection, eliminating typographical errors. Finally, these graphic interfaces are as comfortable for advanced users as they are for novices: they do not suffer from the problem of text based command interfaces that are either verbose (easy for novices, annoying for familiar users) or curt (fast for advanced user and unusable by novices).

Some examples illustrate how such a system could support senior Navy acquisition managers:

Display Form	Example
line graph	cost vs inflation
line graph, overlayed	cost vs time for various inflation rates
point plot	average cost or schedule variance by contractor (Navy-wide)
bar graph	cost or schedule duration for various acquisition strategies
bar graph	schedule duration for various contingencies, e.g., tasks interrupted by funding delays, labor action, delayed or changed GFE, design changes. These can be based on results computed using decision support tools described in next section.
tabular	preformatted reports (e.g., NSATS, SAR)

A wide range of this technology has been demonstrated on applications from SDMS (Spatial Data Management System), a large tool, to Apple computer graphics, costing a few thousand dollars.

F.2.3.2 Decision Support Systems

A newly emerging class of systems, called decision support systems, appears to be applicable to acquisition management. Decision support systems are structured with standard user interfaces (graphic or text based) to which applicable functions for user selection are added. They generally start small, with a core group of generic functions like:

- plot (bar graph, paint plot, line graph, histogram)
- tabulate
- statistics
- sort
- ntiles (percentiles, quartiles)

that are application independent and add special functions like:

- PERT chart scheduling
- PERT based schedule sensitivity analysis
- resource reallocation analysis
- cost vs inflation analysis

- cost estimating
- cost/schedule variance calculation

that are application dependent. These systems feature simple data handling and allow for growth in the set of allowable functions.

Decision support systems are suitable for acquisition management because they are particularly responsive to differing or changing styles of management, growing data manipulation needs, and growing needs based on new experience and learning. Often, decision support systems can be implemented quickly -- within a matter of months for the starting version -- and can grow in a manner responsive to need. New requirements are often discovered by observing uses of the functions available and the information produced.

Some examples will help show how decision support systems (DSS) apply to acquisition management:

Example: Consider a DSS with the following capabilities:

- PERT or CPM type modeling (like PROMAP or TRANSIM) allowing task scheduling based on task dependencies and resource allocation
- sorting
- bar charting

This DSS has a graphic display capability.

In one scenario, an acquisition manager is interested in determining the schedule duration for two ship acquisi-

tion projects given a set of shipbuilding resources to allocate. The DSS would be used in the following way:

Step 1 - In gross detail develop the task dependency chart for each acquisition, noting resource requirements for each task with each acquisition. These task dependency networks are saved.

Step 2 - Define some ship building resource allocation between the two depending networks.

Step 3 - Exercise (simulate) the networks, yielding a schedule (with its total duration) for each.

Step 4 - Repeat Steps 2 and 3 for different resource allocations. The result will be a set of data organized like

< resource allocation, duration of project b>
< resource allocation #2, duration of project a, duration of project b>
.
.
.

Step 5 - Sort the results of Step 4 according to the larger of the durations.

Step 6 - Plot the bar chart, showing resource allocation on the left (vertical) axis, with duration of both projects along the bottom (horizontal) axis. The result, shown in Figure 2.1, displays the resource allocation in preferred order.

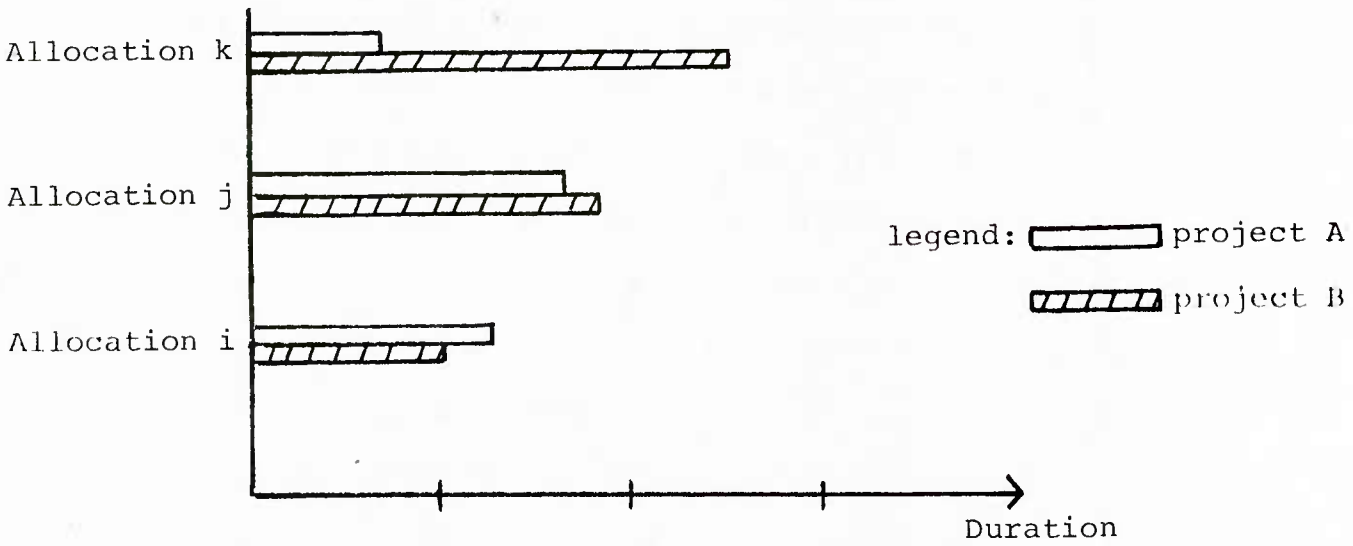


Figure F.1

F.2.3.3 Heterogeneous Distributed Database Technology

Senior managers must often make complex, multi-factor decisions based on inadequate information. Ironically, much of the information they need exists in computerized databases in the acquisition community or in commercially offered databanks. As computing and storage costs continue to decline, the wealth of available information will increase rapidly. But with current practice, the senior decision maker would be no better off.

With respect to computerized databases, the manager's problem is access. His information needs are very broad: the state of the economy, the outlook in the shipbuilding industry, the pending budget actions in Congress, and the status of a large set of diverse, autonomously managed acquisition projects having operations dispersed around

the country. In contrast, the scope of any individual database is narrow: databases tell you a lot about a particular subject. The senior manager faces a dilemma: he cannot build the database he needs, since this would require too much information on too many subjects. He typically cannot afford the time to assemble - for any given decision - all the bits and pieces of information he might want from the many databases that contain information relevant to that decision. (Even if the manager had the time to wait for the information to be assembled, he would find that no one individual knows where it all is, and that the mechanics of assembling and combining it are overwhelming.)

Fortunately, the technology to overcome this problem has been developing for several years and is now in the first stages of practical application. It is now feasible to develop a computer system that will retrieve information from many online databases and will combine and assemble the information to answer a single question. This means that the senior manager can employ an information strategy based primarily on exploiting existing information resources, rather than undertaking the development and maintenance of massive separate databases for the management function.

With the new technology, it is feasible to tap into a set of online databases that are: (a) heterogeneous, meaning that they may be stored on a variety of types of com-

puters in varying data structures and formats, and accessed through diverse languages; and (b) geographically distributed. This is feasible as a result of recent synthesis of advances in database languages, data models, data translation techniques, and distributed database management. While generalized systems are still in the research stage, practical applications of the technology in specific areas are feasible now. For example, the federal government is currently using a system to access and integrate data from 6 different online systems - containing over 25 databases on chemical substances.* As a result of using this technology, it is practical to make more informed decisions.

The potential impact of this technology on the acquisition management process becomes obvious only in the light of available data. There are hundreds of automated systems in the acquisition community. Many of these contain online databases relevant to some aspect of the acquisition management process. The Coordinated Ship Data System contains data on ship production status and plans. The ADCAP system contains data on deficiencies which may affect ship cost and schedule. The Long Range Planning System contains data on ship schedules, manpower loadings, and dry dock and berthing requirements. There are now

* See "An Intelligent Terminal for Access to Heterogeneous Chemical Information Systems," Aren J. Horowitx, Donald E. Eastlake III, and David Low, presented to the annual meeting of the American Society for Information Sciences, October 6, 1980.

some 600 online databases available from commercial vendors. Data Resources Incorporated offers macroeconomic data used in forecasting economic conditions, interest rates, inflation rates, etc. Disclosure Incorporated offers data on corporations, based on filings with the SEC. Dun and Bradstreet offers services based on the largest proprietary database in the world. The New York Times Information Bank and the Wall Street Journal each offer data - retrievable by individual, company, industry and other subjects - on business news. Most of these database services are aimed at serving large business organizations and in some way relate to the needs of senior decision makers in the acquisition community. The online information industry is expected to quadruple in size over the next 5 years, greatly increasing the information available to assist in management decisions.

By all accounts, a similar acceleration of the use of online databases within large organizations can be anticipated. Thus, the amount of information of potential value to the acquisition manager in government databases will also increase.

In summary, the broad information requirements of senior acquisition managers are best addressed by tapping into the growing set of online databases maintained by the Navy and the information industry. This wealth of information can be exploited through the application of advanced database technology just now coming into practi-

cal use. With the new technology, a minicomputer based system can retrieve and integrate data from diverse, geographically dispersed databases. This strategy enables the acquisition community to increase the value of its existing investment in online systems while taking advantage of new systems and databases as they develop. It enables managers to begin to close the information gap, without themselves undertaking commitments to maintain and operate databases.

F.3 Prototype System

One can envision an acquisition management support aid combining decision support system (DSS) concepts with graphics and heterogeneous distributed data management technology. In this section, we describe such a system, present an example of its use, and propose a scheme for a prototype and incremental development.

F.3.1 System Concept

The acquisition management decision support aid would operate as a small system supporting a high resolution color graphics terminal. The terminal would have a keyboard, as a minimum, and potentially a color plate and joy stick. The system would have a graphics-oriented interface for user command processing and for execution and

display of results. The decision aid would connect to various databases and information systems through network and dialup facilities. This is shown in Figure 3.1.

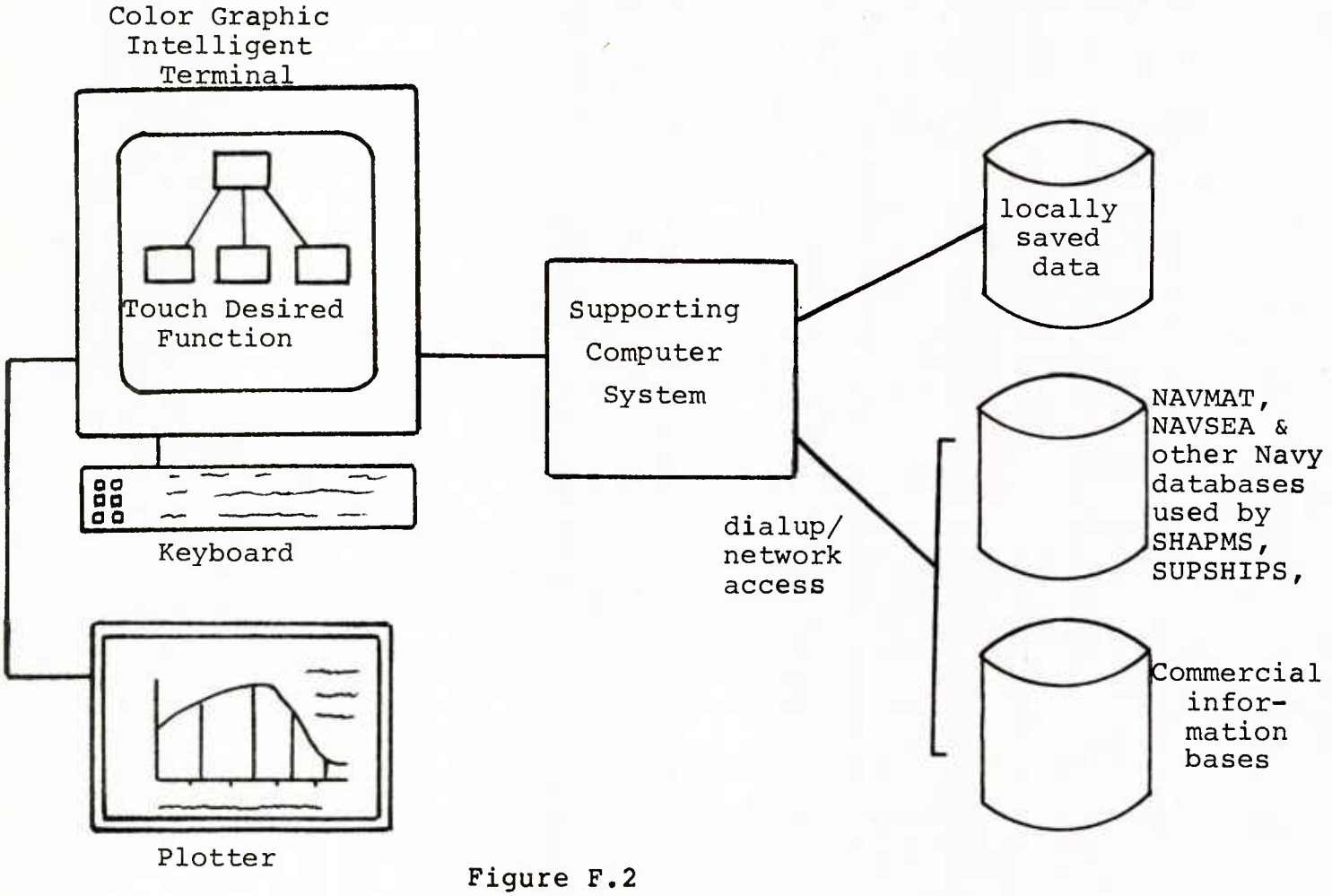


Figure F.2

The support aid would have at least three classes of functions available through the terminal:

(1) Generic functions:

Display	Manipulate
-plot lines graph	-compute (arbitrary)
-plot bar chart	-calculation of formulas & tabulations
-plot pie chart	-alphabetize
-plot points	-rank...by (sort)
-format & display tables	-intiles (percentiles, quartiles)
-display matrix	-average
-others as needed	-count
	-minimum, maximum, others as needed

(2) Acquisition management specific functions:

- task dependency network creation, simulation (for scheduling, resource allocation)
- cost estimation
- task planning and manpower loading
- (CS) type project trading
- others as needed

(3) Data Management

Data Access	Data Manipulation
-browse	-reformat
-query for data with specific condition	-combine (JOIN)
	-collect
-retrieve (copy)	-save
-others as needed	-others as needed

Workspace Manipulation

-hold (on a temporary "page")

-look at different page

-others as needed

F.3.2 Scenario

To appreciate how such a system could operate, we present an example problem and use of the system to solve the problem.

A senior Navy acquisition manager is confronted with the need to develop an acquisition strategy for a particular project. Three shipyards have expressed interest in supporting this acquisition, although one has some of its facilities tentatively allocated to another project. However, the acquisition manager has the freedom to modify that resource allocation, if the need is sufficient.

Information Requirement 1: The manager is interested in finding out as much as possible about each shipyard, even

though much information may already be known.

Step 1: The Acquisition management support aid is used to access the New York Times Information Bank to find articles about each of those shipyards and its parent company (if any). This information is saved, classified by company.

Step 2: The Disclosure, Inc., data service is accessed to provide information filed with the SEC by each of the shipyards or their parent companies. This information and the results of Step 1 are collected and saved.

Step 3: A procurement information system such as NAVSEA Active Contract Report and Completed Contract Report sponsored by NAVSEA 0212 is accessed for information on all contracts using the shipyards of interest. This information and the results of Step 2 are collected and saved.

Step 4: Some sample of the cost and schedule variances is collected from the results of Step 3, for each of the three shipyards. The following calculation determines the relative performance of the shipyards, based on the sample selected. The sample is assembled as a set of "records" of the form

<contractor, contract#, sched variance, total schedule, cost variances, total cost>

Step 4a: Compute variance percentages, yielding <contractor, contract#, schedule variance % (SV%) cost variance % (CV%)>

Step 4b: Compute a relative measure by adding the % variances, yielding <contractor, avg SV%, avg CV%, total var %>.

Step 4d: Rank by total var %.

Step 4e: Produce a bar chart showing contractors' average schedule and cost variances. See Figure 3.2.

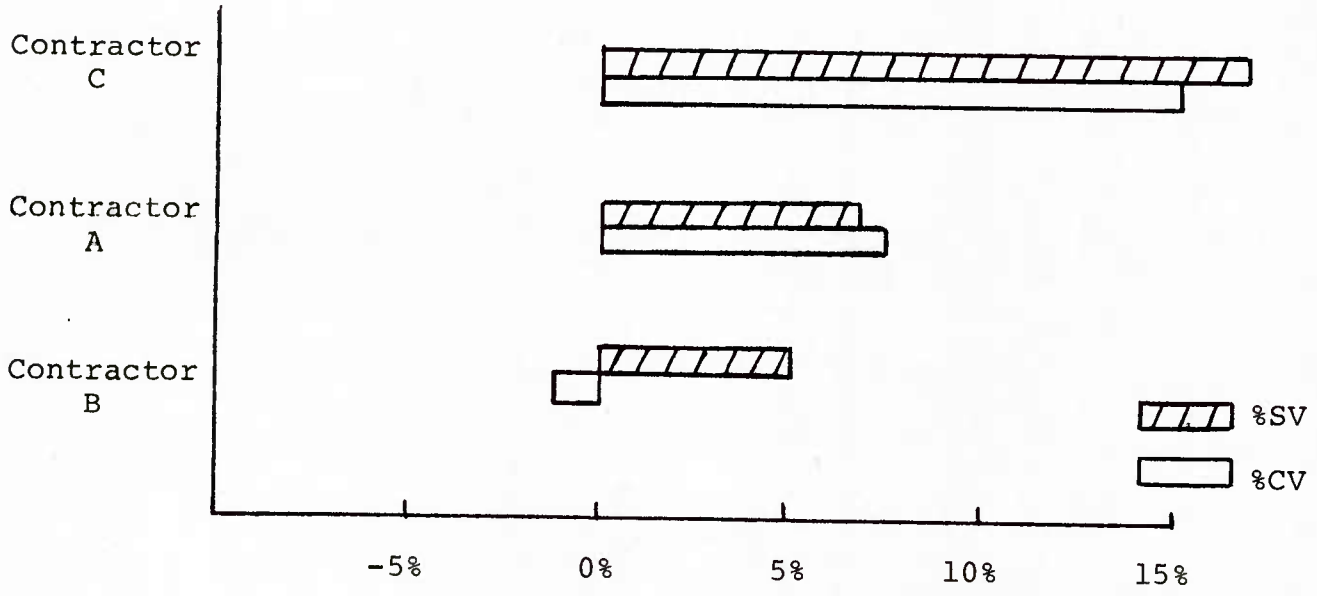


Figure F.3

The result of Steps 1-4, then, is an assessment of the three shipbuilders. The second information need is for an assessment of the impact of different acquisition strategies, e.g., one vs two shipyards. In this example, assume that contractor C has now been eliminated from

immediate consideration because of performance and other factors discovered in steps 1-3.

Information Requirement 2: The manager is interested in varying allocation of resources (shipyards) to the acquisition to evaluate the effects. (This is performed as described in the earlier section.)

Step 5: Construct the major tasks and the task dependency networks for each ship of the new project (New) and the project for which shipyard A tentatively has resources allocated (Old). Replicate this network for each planned ship in the new and old projects.

Step 6: Allocate shipyard facilities to each such network; exercise the network to get a schedule duration for old and new projects.

Step 7: Repeat Setup 6, covering several allocations to include at least the following strategies:

a. Shipyard A facilities -> old project
   Shipyard B facilities -> new project
   (This is a baseline for comparison).

b. Shipyard A facilities partitioned -> old
   -> new
   Shipyard B facilities -> new

c. Shipyard A facilities -> old (until complete)
   then new
   shipyard B facilities -> new

The results are collected in the form <allocation

(a,b,or c), duration O, duration N>.

Step 8: Rank by maximum of duration for O and N.

Step 9: Produce bar graph of form shown in Figure 3.3.

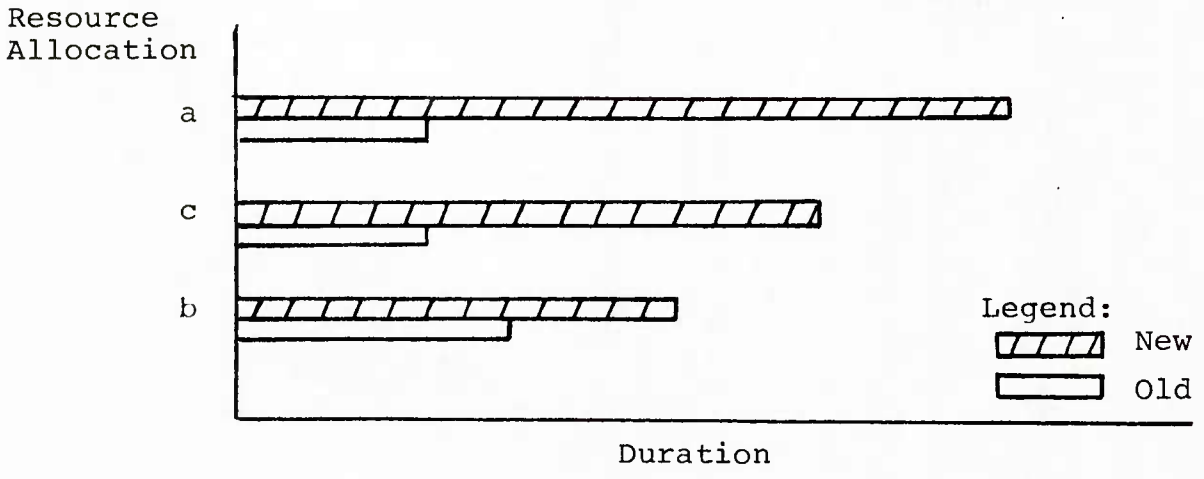


Figure F.4

The result of steps 5-9, then, is an assessment of project duration of both old and new projects based on different resource allocations. A similar projection could be developed for cost of both projects.

F.3.3 Prototype and Experiments

The incremental development of such a system would allow near term support for ship acquisition mangement and would incrementally provide desirable features. We can recommend a series of implementation steps intermingled with experiments that assess the desirability of implementing various capabilities or access paths:

1. Implement a standard user interface applying the graphics technology.

2. Using dummy functions (with realistic names), develop a mockup of a simple DSS. Run an experiment with selected users attempting to use the system. The experiment should assess the useability of the interface for various levels of pre-use instruction and various levels of familiarity (experience with the interface).

3. Revise the standard interface as needed.

4. By averaging a number of methods (open ended survey, questionnaire, observation), select some important scenarios for decision-making. Hypothesize desired DSS functions and required data access for implementation. Test this hypothesis by surveying the immediate acquisition management community. Access the expected benefits.

5. Implement the new functions and provide for data

access in some form consistent with the scenarios. Observe use of the DSS, using software to record usage statistics, and compare actual use to expected use. Measure actual benefit of use. Determine accuracy of benefit projection. Determine whether use of the system was consistent with the scenarios selected early in Step 4. Determine also what other scenarios the system is being applied to; i.e., identify unplanned uses of the system.

6. Based on the new capabilities of the acquisition management organization (with the support aid), go back to Step 4, hypothesizing new functions and data access for implementation.

7. Over a longer period (perhaps two cycles of steps 4-6), measure the growth of DSS capabilities, the enthusiasm for new capabilities, the actual use of the capabilities, and the benefits perceived.

This procedure, conducted over the life of a prototype project, effectively assesses

1) application to the acquisition problem and in its application to the user interface;

2) the Decision Support System approach, the growth and utility of the functions;

3) the need for specific and general data access mechan-

isms; and

4) the accuracy of benefits projections.

Thus, at the end of such a prototype, the Navy will have a useable tool and an understanding of the needs and benefits of further development in acquisition management support systems.